Compressed Air Magazine

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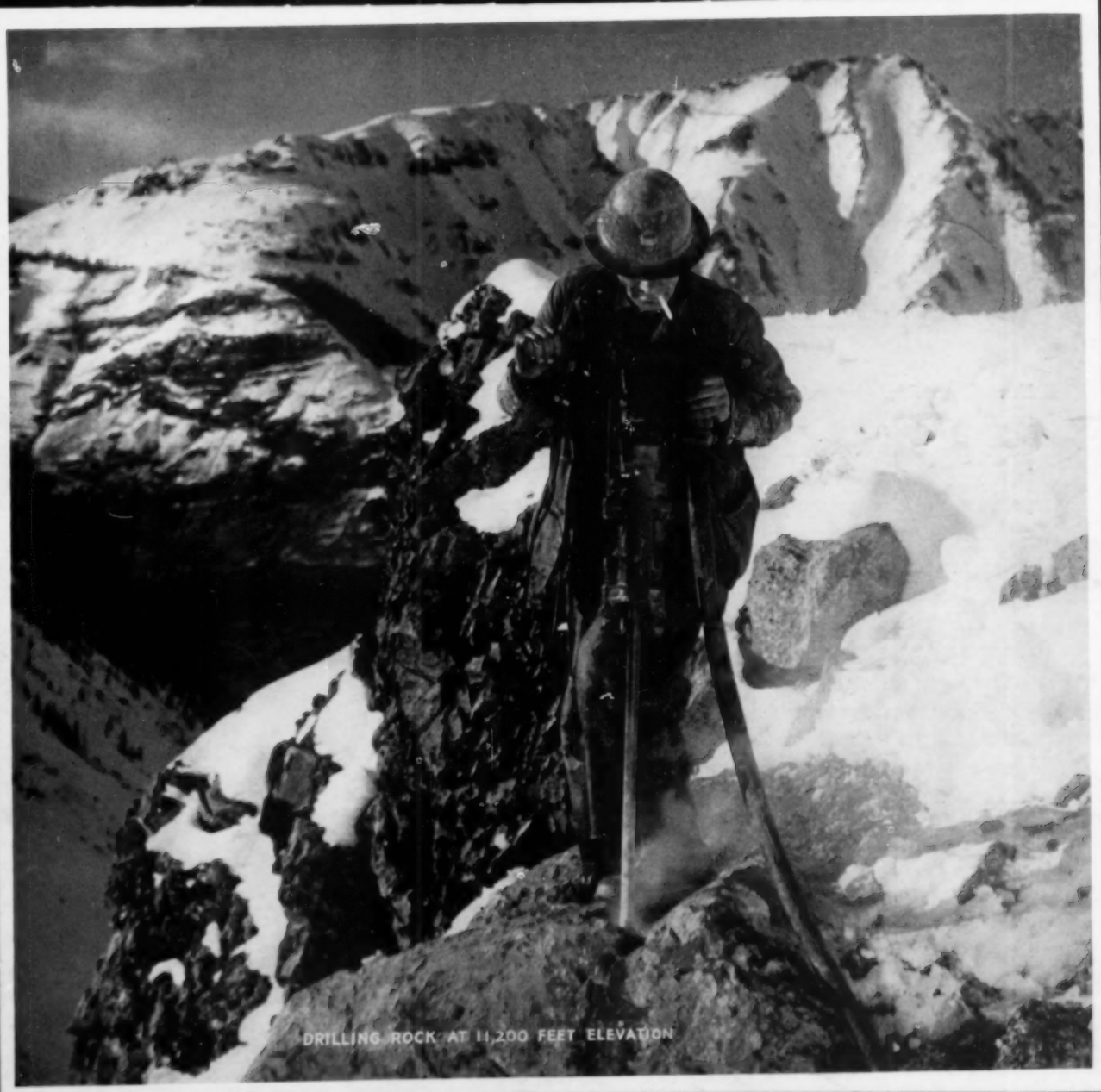
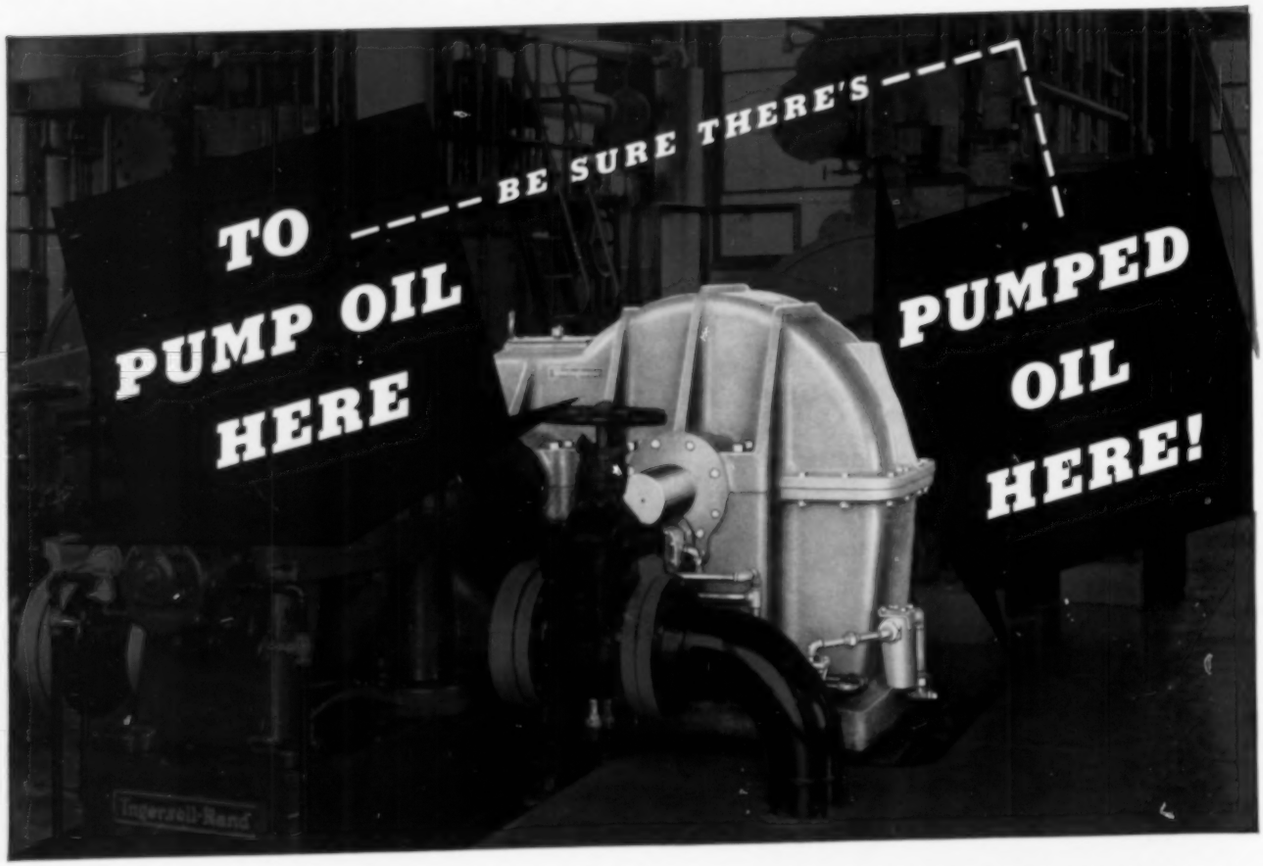


DRILLING ROCK AT 11,200 FEET ELEVATION

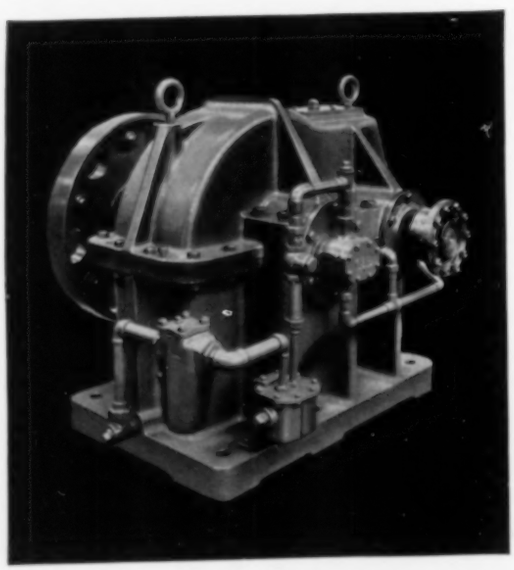


PRESSURE-LUBRICATED SPEED INCREASERS INSURE LONG-LIFE DRIVES

For oil to flow dependably through pipe lines, oil must flow dependably to the high-speed gears that drive the pumps. Westinghouse Speed Increasers insure quiet, continuous operation for pumps, compressors and similar equipment, because their lubrication is insured by positive pressure feed.

Oil pumped constantly against the mesh line of the gears prevents gears or bearings from ever running dry. All parts of the circulating lubrication system are externally mounted and easily accessible.

Westinghouse Speed Increasers are individually designed to exact requirements of prime mover and the machine they are to drive. They can be used to increase output speeds of Diesel engines, gas engines or electric motors. Write for booklet DD-3650 containing details and application data. Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., Dept. 7-N.

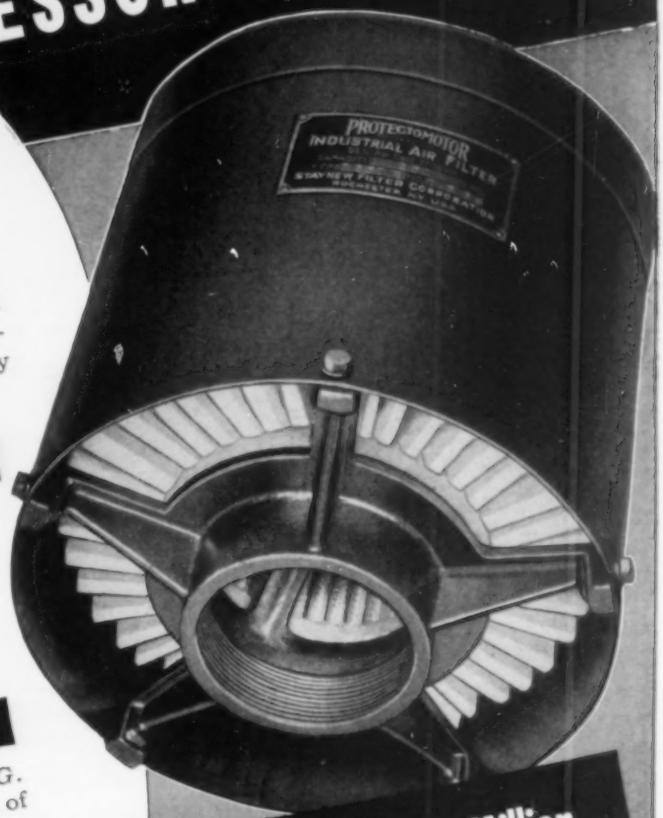


Westinghouse Type SU-14-8 Speed Increaser showing forced-feed lubrication system with pump, cooler and strainer externally mounted.

J-07188

Westinghouse Geared Drives

WHY PROTECTOMOTOR INTAKE FILTERS ARE BEST FOR AIR COMPRESSOR USE



★ HIGH EFFICIENCY WHEN INSTALLED

All Protectomotor Air Filters for internal combustion engines and compressors feature the exclusive, dry-type Feltex Filtering Medium. This medium passes air freely, yet restricts the passage of even microscopic dust particles. Used in the patented Radial Fin Construction, tests made by the University of California show it to possess an efficiency only .1% less than absolute.

★ INCREASED EFFICIENCY WITH USE

A limited amount of dust clings to the outside of the filter medium during use. This amount is limited by vibration transmitted from the engine, which shakes off most of the dust. The remainder acts as a filter, *increasing* efficiency with use instead of decreasing it, as in liquid-type filters.

★ LOW RESTRICTION TO AIR FLOW

Protectomotors used as rated offer *only* ½" *W. G. restriction to air flow*, yet after months or years of use this restriction will not increase to more than an inconsequential 1" W.G.—remaining at this point during the life of the filter—due to the Radial Fin Construction which permits the largest possible area of filtering surface to be used in the smallest possible space, plus the shaking action of engine vibration on the vertical fins.

★ SERVICING SELDOM NECESSARY

The Protectomotor is a masterpiece of simple, rugged construction. There are no moving parts, no reservoirs, no liquids. The only servicing ever required is the removal of the Insert for cleaning—perhaps once a year under average conditions. Cleaning can usually be effected in 5 or 10 minutes with compressed air or a stiff brush.

★ LONG LASTING ★ ★ ★

Massive, over-gauge materials are used throughout, corrosion proof wherever required, without moving parts to wear out or break; it is not surprising that many Protectomotors have been in continuous use for more than 10 years.

More than Half a Million Installations on Internal Combustion Engines and Compressors since 1920

Write for Catalog and Data Blank for Free Analysis of your Requirements

Radial Fin Construction

PROTECTOMOTOR AIR FILTERS — 99 9/10 Per Cent Efficient

STAYNEW FILTER CORP.
7 Leighton Ave., Rochester, N. Y.
"Air Filter Headquarters"

Steve says iron mining's improved—but we'll do it better yet

"Seems like when it comes to building and defending America, our folks always can improve ways of doing it. Every so often we've had to produce more iron ore faster and cheaper, and we've always come through.

"The way we're taking ore out of the range today wouldn't have been possible twenty or thirty years ago. Of course, we were producing big then for railroads, trolley lines, buildings, and bridges. Then came automobiles, and production jumped up plenty.

"We were doing a good mining job then, but we didn't have the powder and caps we got now, or the equipment for drilling and handling.

"Those Hercules people have done a lot to help us shoot the ore better. First off, they came along with that

Hercomite* powder to do the blasting jobs at lower cost. Then it was Gelamite*, and wasn't that something! I'm not saying the regular Hercules gelatin powders don't do a fine job—none better. But most places, Hercomite and Gelamite do just as well. And where you can use them, they knock our costs down like they knock down the ore.

"Believe me, those Hercules service men are on the job, too. They know how their stuff should be shot. It's going to be hard to improve blasting much more, but I'm betting we do. And I'm betting Hercules powders and service men will lead us to it."

HERCULES POWDER COMPANY
INCORPORATED
932 KING STREET, WILMINGTON, DELAWARE

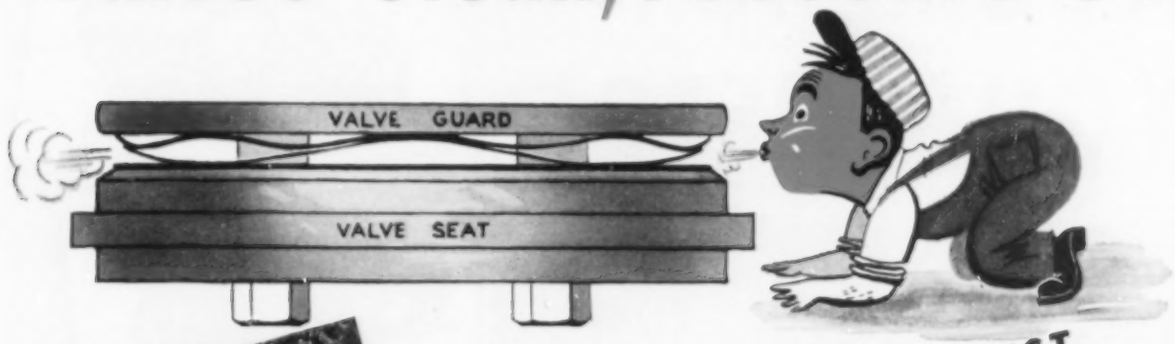
*Reg. U. S. Pat. Off., by Hercules Powder Co.

C-21

HERCULES

EXPLOSIVES AND BLASTING SUPPLIES

Valves Clean, Pressure UP!



SULLIVAN "Dual-Cushion" valves securing variable spring tension by the use of wave-shaped springs and reaction plates. Valves of every design stay carbon-free, in compressors lubricated with Texaco.

CARBON JUST BLOWS AWAY

VALVES will stay clean longer and air pressures will stay up . . . regardless of the size or type of compressors you operate when you use *Texaco Alcaid, Algol or Ursa Oils.*

Using *Texaco Alcaid, Algol or Ursa Oils* the little carbon that may form will be *soft* and *fluffy* . . . will be carried away with the compressed air. Highly resistant not only to carbon formation, but also to gumming and sludging, these oils assure efficient valves, longer service between inspections and cleanings.

The outstanding performance that has made Texaco preferred in the fields listed in the panel has made it preferred also by compressor operators everywhere.

These Texaco users enjoy many benefits that can also be yours. A Texaco Lubrication Engineer will gladly cooperate . . . just phone the nearest of more than 2300 Texaco distributing plants in the 48 States, or write:

The Texas Company, 135 East 42nd Street, New York, N. Y.

THEY PREFER TEXACO

★ More revenue airline miles in the U. S. are flown with Texaco than with any other brand.

★ More buses, more bus lines and more bus-miles are lubricated with Texaco than with any other brand.

★ More stationary Diesel horsepower in the U. S. is lubricated with Texaco than with any other brand.

★ More Diesel horsepower on streamlined trains in the U. S. is lubricated with Texaco than with all other brands combined.

★ More locomotives and cars in the U. S. are lubricated with Texaco than with any other brand.

FOR YOUR ENJOYMENT • TWO GREAT RADIO PROGRAMS

FRED ALLEN every Wednesday night. See your local newspaper for time and station.

METROPOLITAN OPERA. Complete broadcasts of great operas every Saturday. See your local newspaper for time and station.

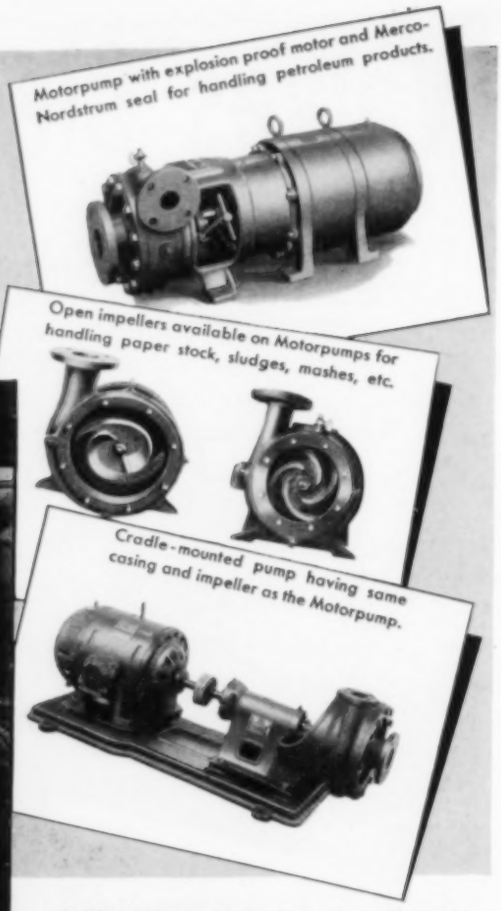
TEXACO

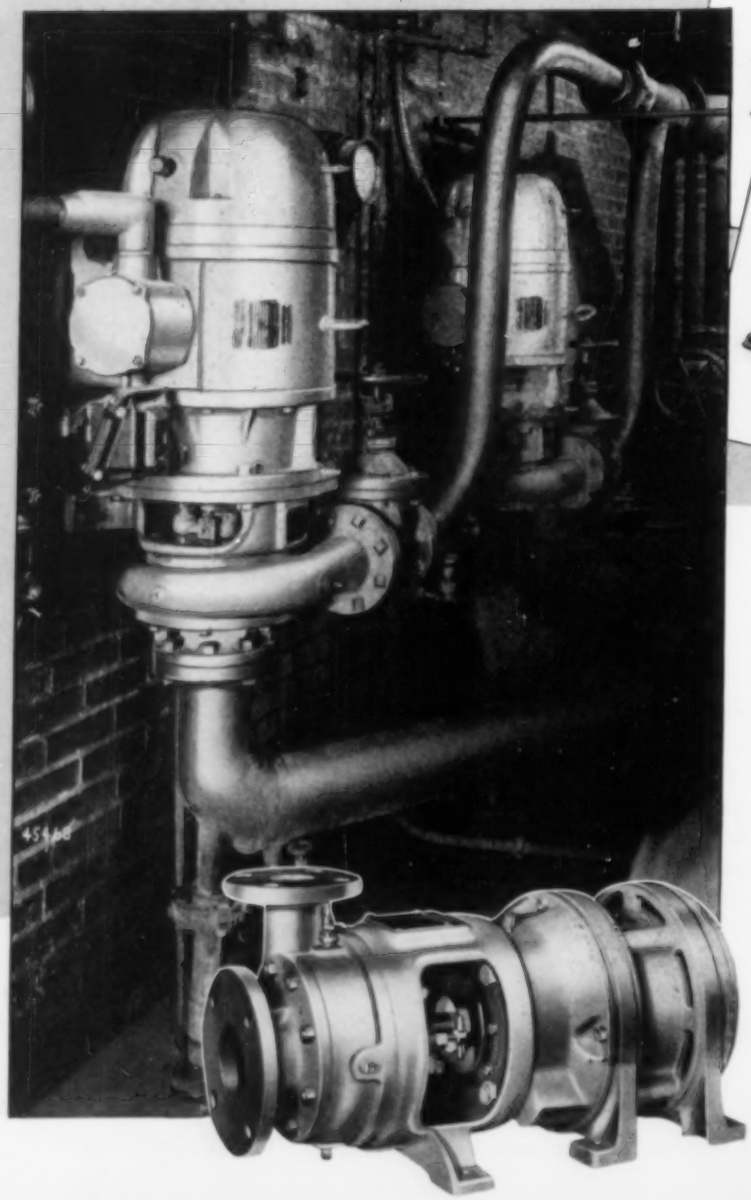
TEXACO Lubricants

FOR ALL COMPRESSORS AND AIR TOOLS

RETURN METAL DRUMS PROMPTLY . . . thus helping to make present supply meet industry's needs and releasing metal for National Defense.

A PUMP TO FIT YOUR NEEDS


Motorpump with explosion proof motor and Merco-Nordstrum seal for handling petroleum products.
Open impellers available on Motorpumps for handling paper stock, sludges, mashes, etc.
Cradle-mounted pump having same casing and impeller as the Motorpump.



● The Motorpump is a versatile unit—it is available with motors of practically any type for all usual current conditions—highly efficient closed impellers are furnished for handling water, oil and other clear liquids. Open impellers are available for handling sludges, paper stock, mashes, etc.—smothering type stuffing box glands can be furnished for hot or volatile liquids.

In short a Motorpump exactly suited to your needs is available. Capacities from 5 to 1500 gals. per min; heads to 500 feet. Shipment from stock.

The Cameron

MOTORPUMP

An Ingersoll-Rand Product

Atlanta, Birmingham, Boston, Buffalo, Butte, Chicago, Cincinnati, Cleveland, Dallas, Denver, Detroit, Duluth, El Paso, Hartford, Houston, Kansas City, Los Angeles, Newark, New Orleans, New York, Philadelphia, Picher, Pittsburgh, Pottsville, Salt Lake City, San Francisco, Scranton, Seattle, St. Louis, St. Paul, Tulsa, Washington, Knoxville

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CAMERON PUMP DIVISION

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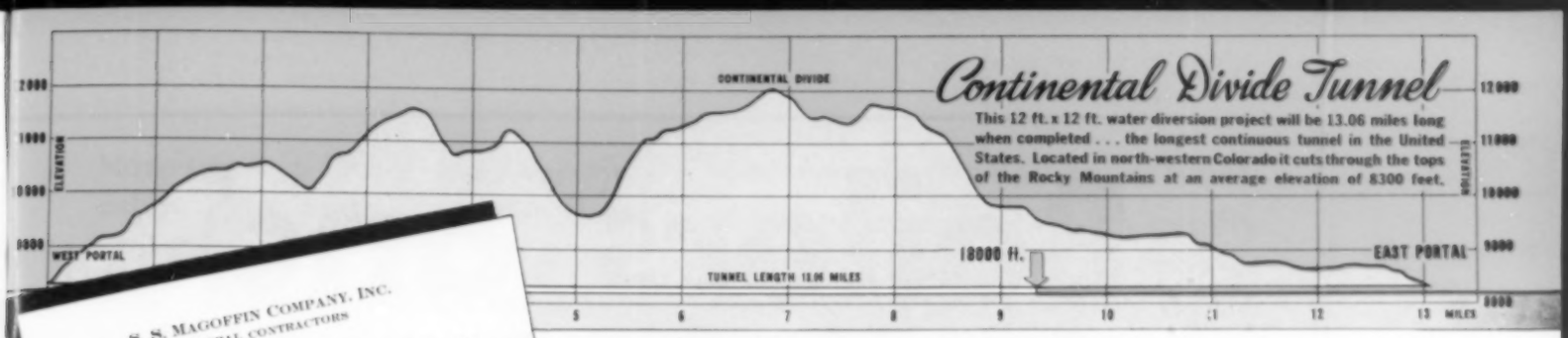

Continental Divide Tunnel

This 12 ft. x 12 ft. water diversion project will be 13.06 miles long when completed . . . the longest continuous tunnel in the United States. Located in north-western Colorado it cuts through the tops of the Rocky Mountains at an average elevation of 8300 feet.

S. S. MAGOFFIN COMPANY, INC.
GENERAL CONTRACTORS

Estes Park, Colo.
October 14, 1941

The Eimco Corporation
Salt Lake City
Utah

Gentlemen:

Please enter our order for another Model 21 Eimco-Finlay Loader. We have general Preference Rating P-19A, No. 9603, A-10, and want speedy delivery.

For your information we made 74 ft. on Friday, October 10th, with tunnel in 16,800 ft.

Yours very truly,

S. S. Magoffin Company, Inc.

F. R. Purvis
General Superintendent

East Portal advanced 74 ft. in 24 hrs. through the time-saving use of

EIMCO-FINLAY LOADERS

Gaining momentum as they move along, the S. S. Magoffin Co., Inc., is rapidly approaching world records for SPEED in driving the East Portal of the Continental Divide Tunnel. The 74-ft. advance achieved on October 16th is only four feet short of the all-time record established (also with an Eimco-Finlay Loader) at the Carlton Tunnel in September 1940. Other East Portal figures, as here given, show conclusively that any competent contractor, using Eimco-Finlay Loaders and other suitable modern equipment, can now drill, blast and load-out from six to nine complete rounds in 24 hours when rock conditions are reasonably favorable.

On this job, as on several other successful tunnel jobs, the S. S. Magoffin Co. has used Eimco-Finlay Loaders exclusively, and their recent order for ANOTHER of our latest-type Model 21 machines indicates, better than any words, their satisfaction with the fast, dependable results secured. Experience has shown, also, that no other type of loading machine can slash through tough muck piles—mile after mile—without injury to any important part and with such amazingly low expense for general operation and upkeep.

Above: Model 21 Eimco Finlay Loader at work in East Portal of Continental-Divide Tunnel. Below: The 92 cu. ft. cars are completely filled in from two to three minutes—actual loading time.

EAST PORTAL FIGURES

Total advance, Oct. 25, 1941	17,412 ft.
Best daily advance, Oct. 16, 1941	74 ft.
Best weekly advance, 160 hrs.	400 ft.
Best monthly advance, May, 1941	1,565 ft.
Average advance per working day	44 ft.
Average depth of round	6½ ft.
Average mucking time per round	80 min.
Average time required to load 92 cu. ft. car, including switching	5 min.

Note: Penalty of $15.00 per cu.yd. for overbreakage compels short rounds with careful lining of holes.

THREE STANDARD SIZES NOW MEET EVERY UNDERGROUND REQUIREMENT

The Model 12-B Eimco-Finlay Loader can be used effectively in drifts as small as 4'-6" wide x 6 ft. high—loads cars up to 50 cu. ft. capacity at the rate of more than a ton per minute. Model 21, with wider clean-up, loads larger cars at the rate of two tons per minute. Model 40 (Eimco Tunneloader) loads the largest cars used underground at the rate of more than three tons per minute. Write for bulletins.

THE EIMCO CORPORATION

Salt Lake City, Utah, U.S.A.

NEW YORK, 120 Broadway — **CHICAGO, 111 W. Washington St.**

EL PASO, Mills Building — **SACRAMENTO, 1217 7th St.**

INGERSOLL-RAND CO., LTD.
165 Queen Victoria St., London, Eng.

DOMINION CONSTRUCTION CO., LTD.
Wellington, New Zealand

MINE EQUIPMENT COMPANY, LTD.
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BRITISH MIN. SUP. CO. (PTY.), LTD.
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B. C. EQUIPMENT CO., LTD.
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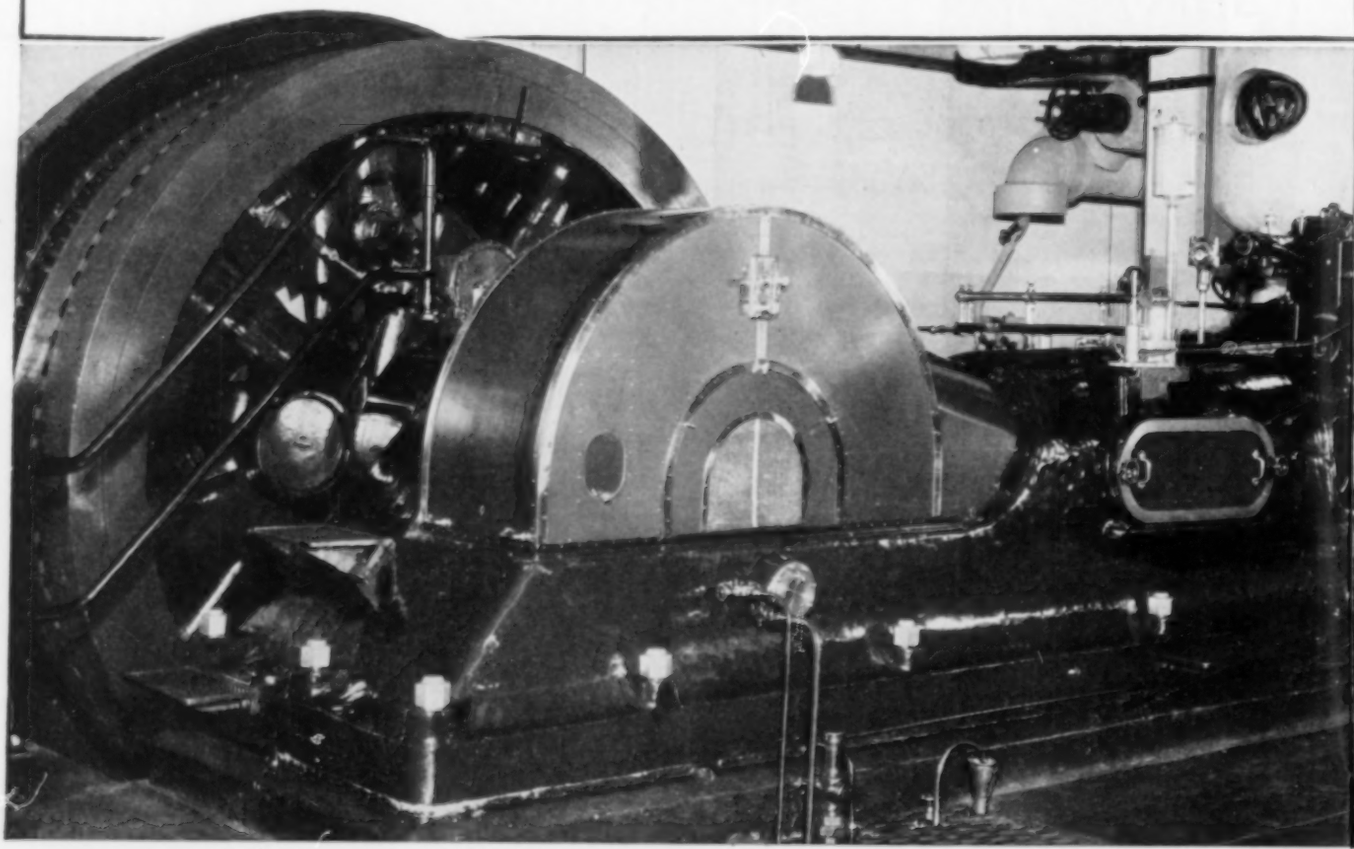
Boulder Road, Kalgoorlie, Australia

MARSMAN TRADING CORPORATION
Manila and Baguio, Philippine Is.

Boilers and Exhaust Steam Stay Clean_

WITH GARGOYLE CYLINDER OIL IN YOUR ENGINE



CALL IN Socony-Vacuum for

YOU'LL BENEFIT FROM: 75 YEARS' LUBRICATION EXPERIENCE • PRODUCTS APPROVED BY ENGINE BUILDERS •

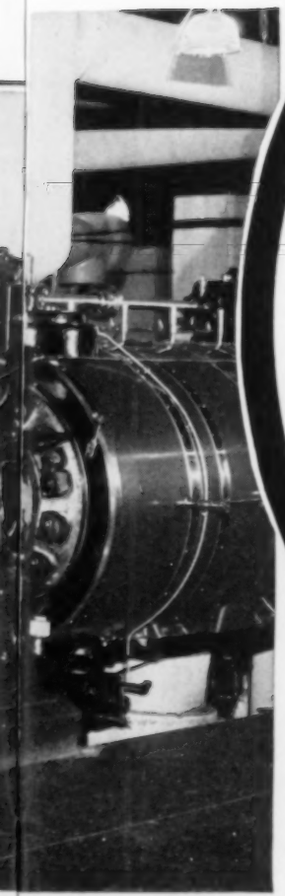
Here are two important operating advantages that Gargoyle Super Cylinder Oil 600-W offers you:

☞ Because this oil separates quickly from condensate, it minimizes oil in your boiler.

That means you get maximum heat transfer through boiler tubes.

☞ And because this high-quality cylinder oil lubricates your engines efficiently with minimum feeds, it helps keep exhaust steam clean.

Result—you get peak efficiency for heating and processing equipment.



GARGOYLE

Lubricants

The Emblem of 75 YEARS' PIONEERING in "Correct Lubrication" 1866-1941

"Correct Lubrication"

THE RIGHT OIL FOR EACH JOB • NEW LUBRICANTS AHEAD OF NEW NEEDS •

SOCONY-VACUUM OIL COMPANY, INC. • Standard Oil of New York Div. • White Star Div. • Lubrite Div. • Chicago Div. • White Eagle Div. • Wadhams Div. • Southeastern Div. (Baltimore) • Magnolia Petroleum Co. • General Petroleum Corp. of Calif.

AS A DOCTOR'S CHECK-UP PROTECTS YOUR HEALTH

. . . a check-up on equipment will prolong the life of wire rope

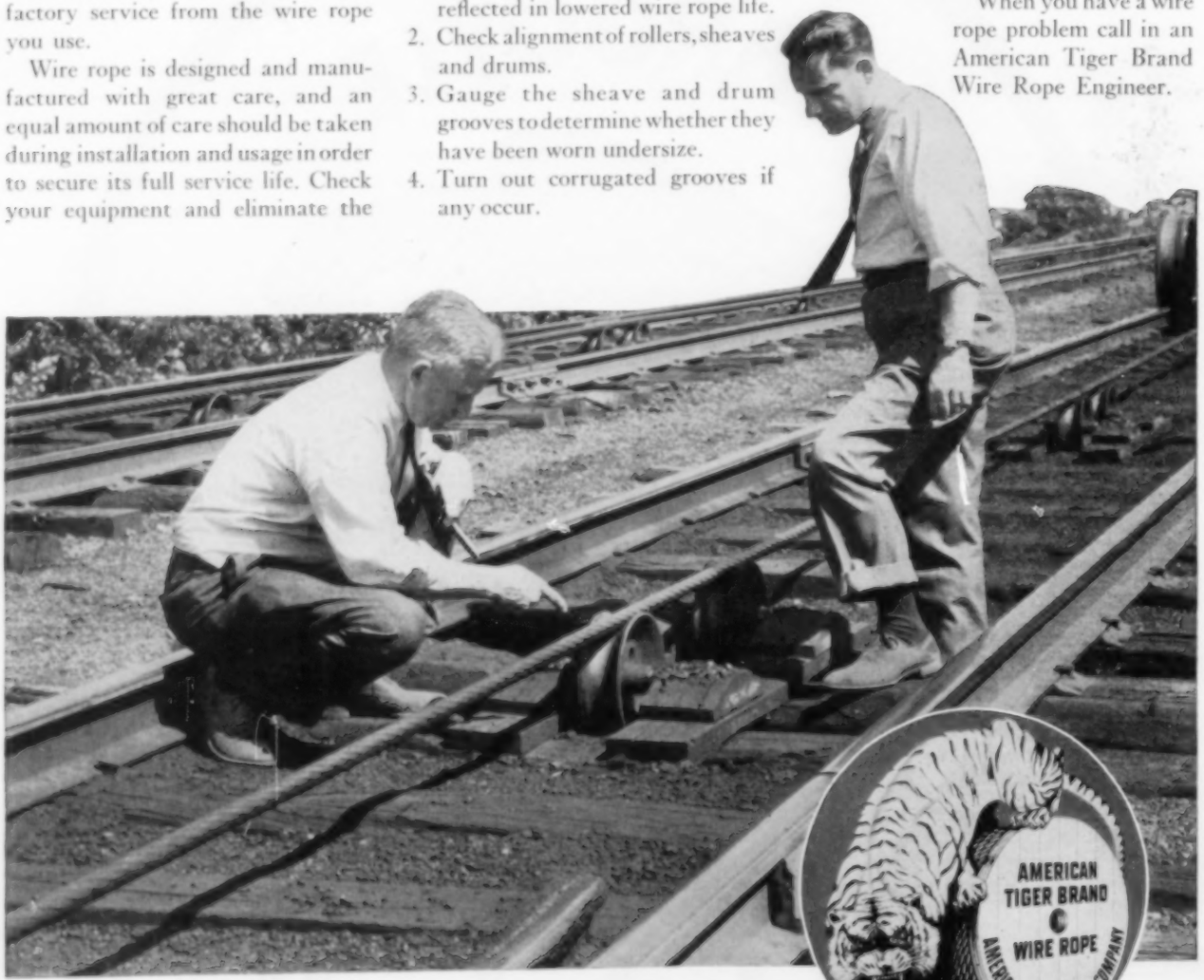
JUST as a doctor's examination will tell you what to do to bring your physical efficiency up to par, a periodical check-up of your equipment will help you get more satisfactory service from the wire rope you use.

Wire rope is designed and manufactured with great care, and an equal amount of care should be taken during installation and usage in order to secure its full service life. Check your equipment and eliminate the undesirable conditions that result in inefficiencies and unnecessary wear.

Here are a few things to remember:

1. Handle wire rope with care, since distortion of its structure will be reflected in lowered wire rope life.
2. Check alignment of rollers, sheaves and drums.
3. Gauge the sheave and drum grooves to determine whether they have been worn undersize.
4. Turn out corrugated grooves if any occur.
5. Test sheaves and rollers to make sure they are rotating freely.
6. Replace or remachine parts that are likely to result in unnecessary wire rope wear.

When you have a wire rope problem call in an American Tiger Brand Wire Rope Engineer.



AMERICAN STEEL & WIRE COMPANY
Cleveland, Chicago and New York

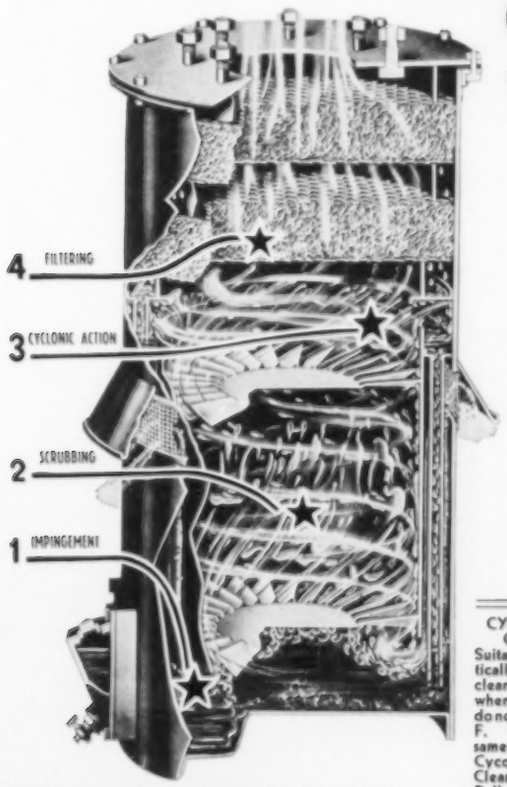
COLUMBIA STEEL COMPANY
San Francisco

United States Steel Export Company, New York

Excellay Preformed

UNITED STATES STEEL

Cycoil CLEANERS WILL KEEP THEM RUNNING *PERFECTLY* LONGER!



Write for Cycoil Bulletin No. 130D which gives complete information on the operation of the Cycoil.

Today—more demands are put on engines than ever before—they *must* run more hours per day—*must* give more years of service! That's why *clean air* is vital to your engine operation. Originally engineered to meet the extreme conditions of the dust bowl areas, *Cycoil* air cleaners not only give outstanding performance under all conditions, but are effective as intake silencers on both engines and compressors.

Engine manufacturers know *Cycoil's* exclusive 4-way cleaning assures positive dust protection. They will be glad to equip your new engines with *Cycoil* cleaners and you pay only a little more for the best.

Write for facts on how *Cycoils* save money, keep engines running *perfectly* longer! There is an American Air Filter for every engine and compressor requirement. Send *today* for full information.

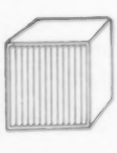
AMERICAN AIR FILTER COMPANY, INC.

Incorporated

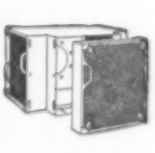
204 Central Ave., Louisville, Ky., U. S. A.

CYCOIL GAS CLEANER
Suitable for practically every gas cleaning problem when temperatures do not exceed 140° F. Operates on same principle as Cycoil Oil Bath Air Cleaner. Ask for Bulletin 130D.

PL-H FILTER
is a complete assembly consisting of housing, ready to bolt to intake pipe, and dry cell type filters in which wool felt constitutes the filter medium. Ask for Bulletin 120D.



TYPE OCH FILTER
Complete assembly consisting of washable viscous impingement type filters. 1, 2, 3, or more cells are used, depending upon size of cleaning job. Ask for Bulletin 120D.



AMERICAN Cycoil AIR and GAS CLEANERS

PISTON RINGS AND PACKINGS

— *in the first line of Defense*

Sealing Pressures — Since 1888

POWER comes before planes, tanks, guns, ammunition, ships, oil, gasoline, electricity—for it is POWER that makes possible large scale production of defense essentials.

★

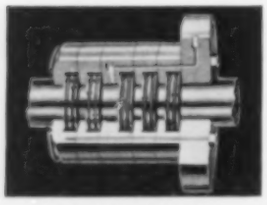
Thus, the Nation's power equipment—its engines and compressors—constitute the first line of defense—and never before has it been so necessary to maintain this equipment at maximum efficiency.

★

In determining the efficiency of engines and compressors—PISTON RINGS and PACKINGS play a vital part. For 53 years, COOK'S Graphitic Iron Piston Rings and COOK'S Metallic Rod Packings have enabled builders and operators of power equipment to get highest efficiency from their equipment with corresponding economy of fuel and upkeep.

★

Today, in addition to supplying COOK'S Rings and Packings in large volume for direct National Defense prime movers, we are meeting the unprecedented demands of operators in industry who are contributing to the defense effort.



COOK'S METALLIC ROD PACKINGS

COOK'S GRAPHITIC IRON PISTON RINGS

★

If you need increased engine or compressor efficiency—or can use help on any problem pertaining to piston rings or rod packings—we're ready to serve you. Call our nearest office or write us direct.

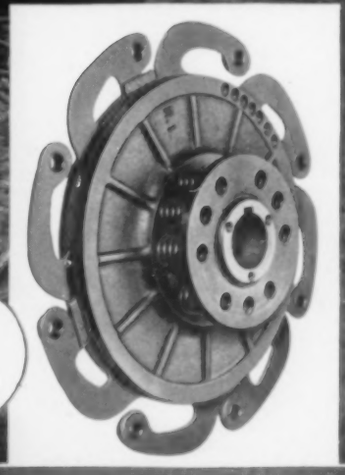
C. LEE COOK MANUFACTURING CO.

INCORPORATED

New York Cleveland — Los Angeles Baltimore — **LOUISVILLE, KY.** — Chicago Tulsa — New Orleans San Francisco

OUT IN THE MIDDLE OF NOWHERE

driving the Portland-Montreal Pipe Line through the Vermont woods, the I-R Mobil-Air Compressors need clutches that function without attention or repairs. Because they are that kind, Flex-Disc Clutches are used on these compressors.

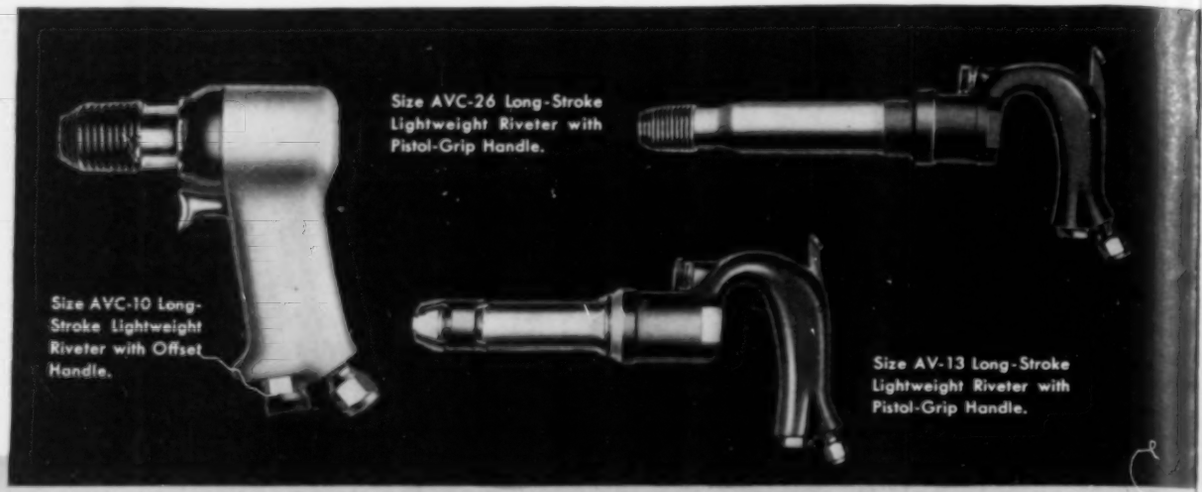


The entire line of I-R *Mobil-Air* Compressors are equipped with Flex-Disc Clutches. U. S. Patent Nos. 2,177,362, 2,259,461, and others pending.

C. M. EASON, INDUSTRIAL CLUTCH CO.

Waukesha Wisconsin

Action COUNTS TODAY!


Size AVC-26 Long-Stroke Lightweight Riveter with Pistol-Grip Handle.
Size AVC-10 Long-Stroke Lightweight Riveter with Offset Handle.
Size AV-13 Long-Stroke Lightweight Riveter with Pistol-Grip Handle.

LIGHTWEIGHT RIVETERS SPEED PRODUCTION

I-R Lightweight Riveters help you keep pace with today's demand for greater production. They combine three all-important features: proper hitting power — delicate control — and light weight.

A complete line of 15 sizes is available with straight, offset or pistol-grip handles. Either slow or fast hitting tools can be furnished.

For complete details of Lightweight Riveters and other airplane tools write for your copy of the new Aircraft Bulletin, Form 2735-A.

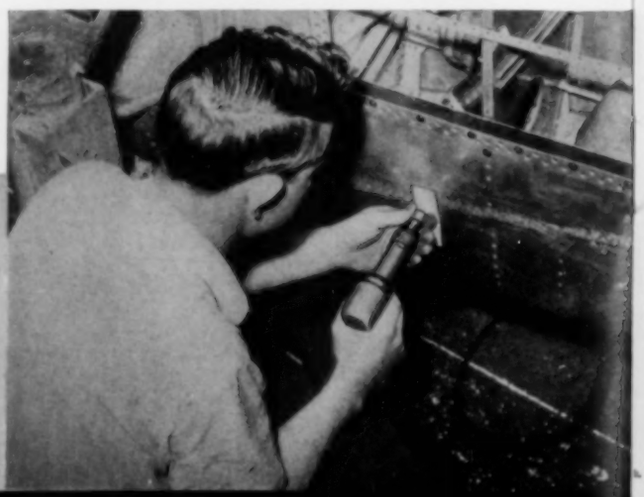
Left Above: A Size AV-12 Airplane Riveter driving rivets in bottom cover of wing.

8-98

Left: Driving countersunk rivets in leading edge of wing with a Size AV-13 Airplane Riveter.

★

Right: A Size AV-12 Airplane Riveter with Offset Handle used to drive rivets in leading edge of No. 1 spar.



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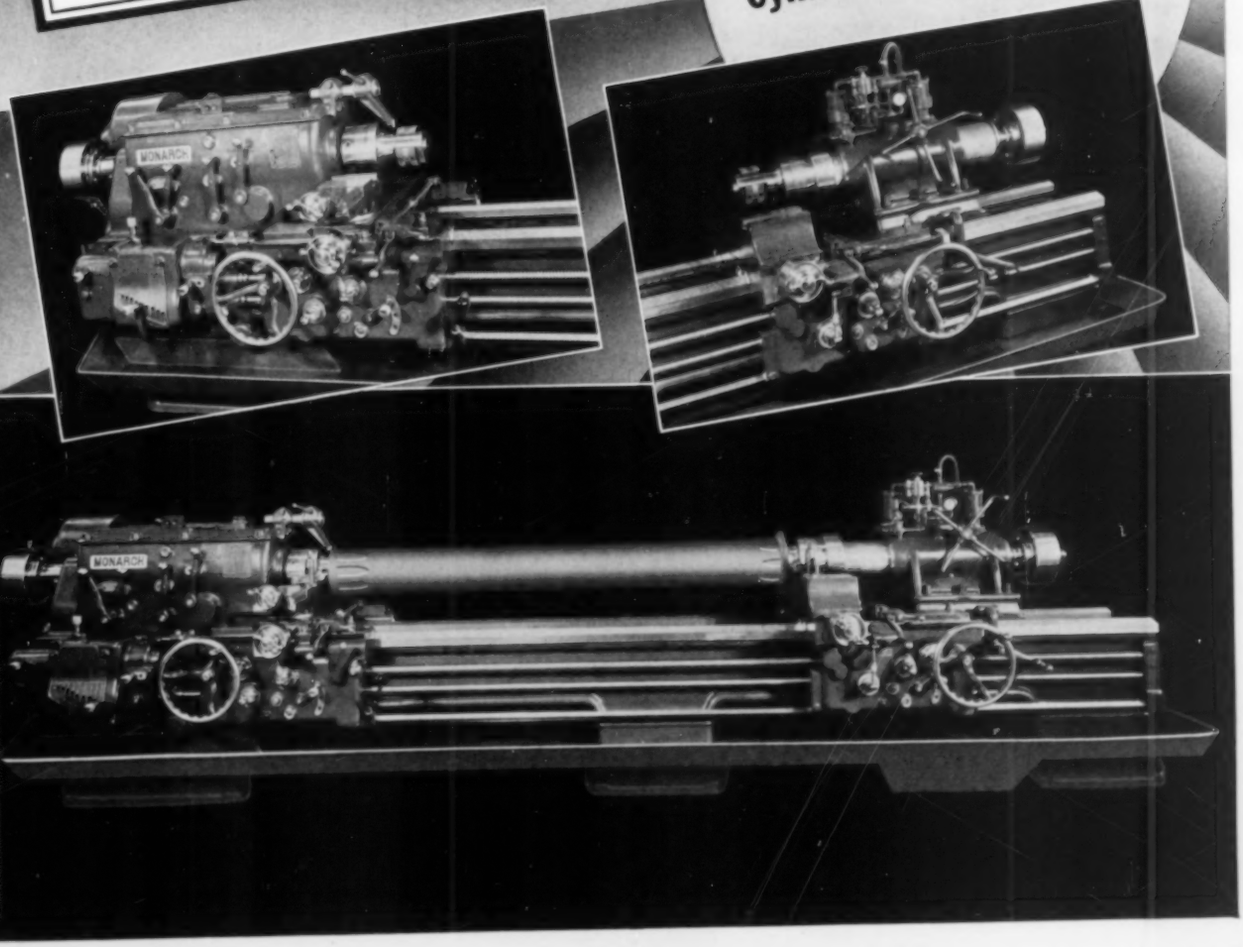
"LOGAN"
AIR EQUIPMENT AS APPLIED TO 20" x 120" MONARCH LATHE

This 16-speed Model "M" Monarch Lathe is designed to machine parts ranging from 14" to 120" in length. The headstock and tailstock are equipped with duplicate "LOGAN" Air Equipment and tooled to face both flanges simultaneously. Controlled by a single air valve, one operator keeps the lathe in constant production. "LOGAN" Expanding Mandrels, with interchangeable jaws to handle the entire range of sizes, support the work. Model R Rotating Type "LOGAN" Air Cylinders operate the mandrels. This heavy duty "LOGAN" Air Equipment assures positive gripping and rigid support of work. "LOGAN" Representatives and "LOGAN" Engineers will be glad to make recommendations on your problems.

LOGANSPORT MACHINE, INCORPORATED
914 Payson Road LOGANSPORT, INDIANA
Manufacturers of Air and Hydraulic Devices, Chucks, Cylinders, Valves, Presses and Accessories

Headstock (left) and tailstock of Monarch Lathe with duplicate "LOGAN" Air Cylinders and Mandrels



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ON THE COVER

OUR cover picture shows a miner using a JB-5 Jackhamer above the portal of the Shenandoah-Dives Mine adit near Silverton, Colo. The photograph was taken by Thomas J. Barbre in October, and it will be observed that considerable snow had already fallen.

•

IN THIS ISSUE

THANKS to two broad oceans, the United States is looking forward to a peaceful Christmas amid a war-torn world. As befits the season, two of our December articles reflect the Christmas spirit. The leading one takes us to a little known New Mexico coal camp that celebrates with true reverence. *Toys of all Times* gives sidelights on an important Yuletide industry.

•

HOW ingenuity, persistence, patience, and modern machinery enabled a tunnel contractor to surmount extremely trying obstacles is told in *Overcoming Underground Difficulties*. It describes the procedure followed in driving one of the most interesting sections of the Delaware Aqueduct.

•

A CONTRACTOR in the Northwest developed three special pieces of equipment to aid him in pouring concrete. Other contractors wanted similar machines, and this led to the establishment of a thriving manufacturing enterprise. For details, read *Three Aids to Concrete Pouring*.

Compressed Air Magazine

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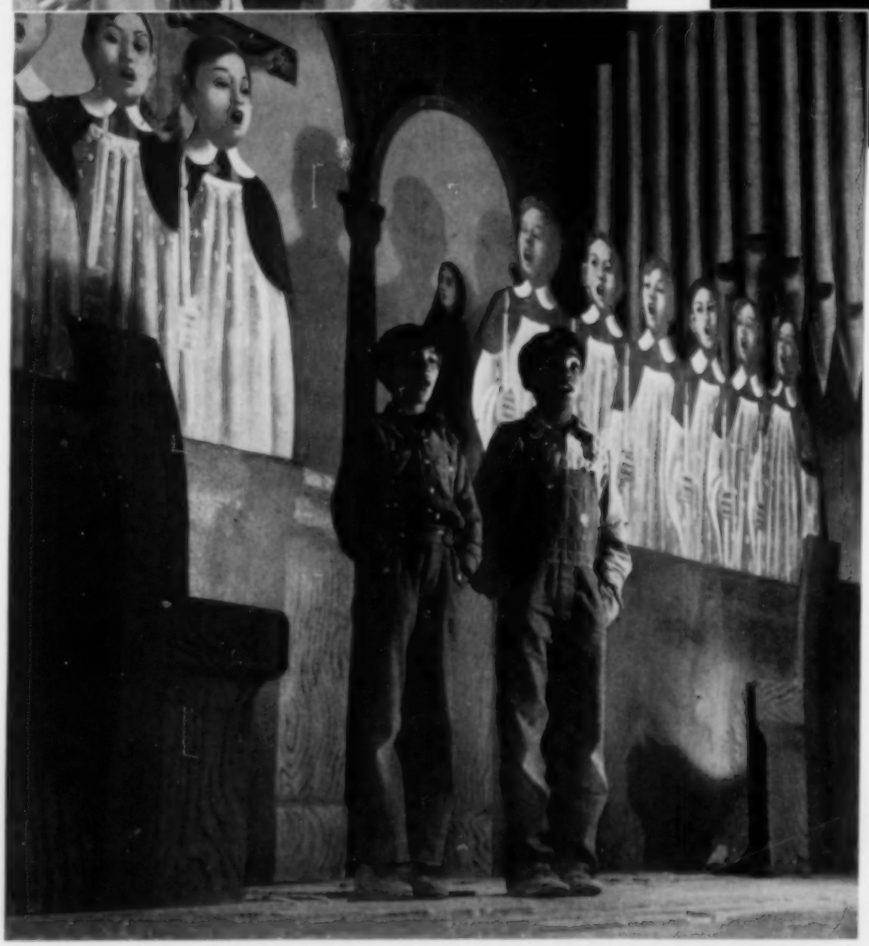
Christmas Comes to

Colorful Celebration by Coal Mining Camp is Unique



THERE are few coal-producing regions where it would be possible to drive a pigeonhole in the slope of a hill and take anthracite out of one side and bituminous out of the other. But that could be done in the Cerrillos District in Santa Fe County, New Mexico. In fact, the record shows that it was done by one enterprising operator years ago, and the old slope which yielded both grades still yawns on a hillside above the Town of Madrid. This practice has been abandoned in the present-day collieries in the field; but the two veins of coal are still mined commercially, with separate slopes for each operation.

The Cerrillos workings have been producing coal for more than 100 years and are said to have been the first to open west of the Mississippi. As far back as 1835 pigeonholes dotted the hillside, and among the first users of the fuel were the Federal troops stationed at Santa Fe and other New Mexico military posts. Drawn by bull team along the rutted path of the Santa Fe Trail, the coal found its way as far east as St. Louis. But those early operations were on a small scale, and it was not until 1888 that commercial mining was begun. About that time the old Atlantic & Pacific Railroad came snorting through the country, and the mines were opened to supply it with fuel. The Atlantic & Pacific became the present Atchison, Topeka & Santa Fe system, and the latter, together with the Colorado Fuel & Iron Company, worked the mines from 1888

Madrid, N. Mex.

Carey Holbrook

YULETIDE TRANSFORMATION

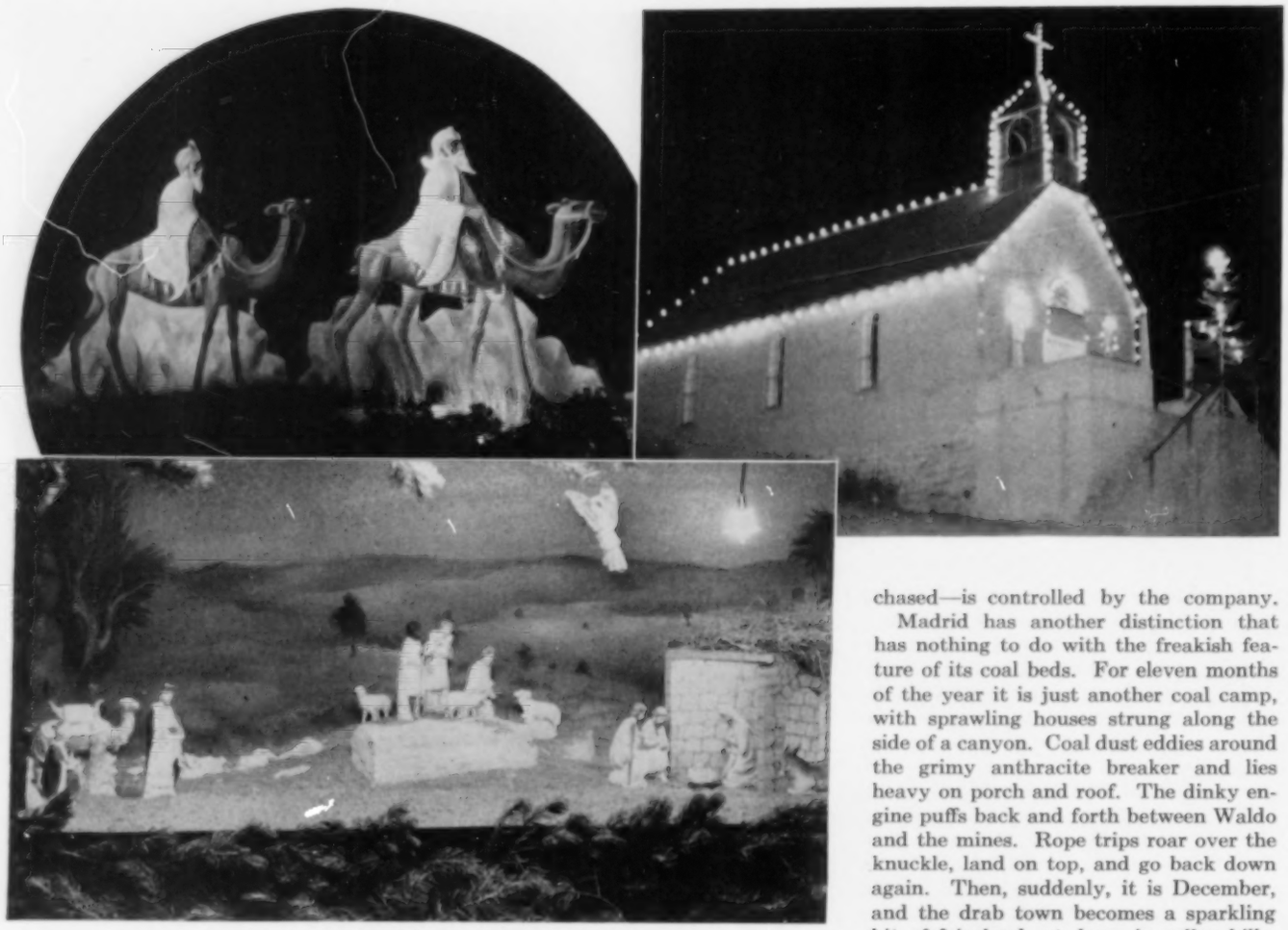
At Christmastide the ordinarily drab coal-mining town becomes an incandescent fairyland. There is no carnival atmosphere and no commercialization. A religious aspect prevails, and Madrid celebrates in solemn reverence. Almost every structure is decorated and illuminated, and in many cases the transformation from day to nighttime appearance is marked. Who, for instance, would suspect that the building pictured above is a barbershop, or that the display for children at the left adorns a schoolhouse? High on a hillside is the choirboy set shown on the opposite page. From it are amplified recordings of hymns so that all may hear them. On the main street a Madrid family pauses to view a representation of the Babe in the Manger (extreme left).

until sometime in 1906, gradually extending them southward along Waldo Gulch to the present site at Madrid. Since 1906 the Albuquerque & Cerrillos Coal Company has operated the property under a lease. It first produced only anthracite, then spread out to include the bituminous coal. For many years G. A. Kaseman was in active charge; but since his death, a few years ago, Oscar Huber, who is now president and general manager, has taken over, with Virgil McKnight as manager of sales. Offices for both sales and operation are maintained in Madrid.

The Cerrillos coal field is located on Galisteo Creek in central New Mexico and west of the Rocky Mountain axis. It is irregular in outline and extends from the Town of Galisteo westward some 12 miles to a point about a mile west of Madrid. In a north and south direction its width varies from around 3 miles near Cerrillos to approximately 8 miles at the eastern end. Within this area are found three distinct grades of coal: anthracite, coking bituminous, and noncoking bituminous. The bed known as the Cook and White contains coking bituminous averaging about 4 feet in thickness in the mines now being worked. Seventy-five to 125 feet above this deposit is the anthracite vein, which varies considerably in thickness. On the north end is clean coal ranging 30 to 42 inches thick, while on the south end there is about a foot of coal on the bottom, 15 inches of parting rock above it, and then 18 inches more of coal.

High on the hillside overlooking Madrid may be seen the break in the structure where the bituminous changes into anthracite. Willis T. Lee, of the U. S. Geological Survey, wrote a bulletin on this field in 1913 in which he said: "Between the White Ash mine, in which the coal averages 5½ feet in thickness, and Anthracite Mine No. 1 the change from bituminous to anthracite takes place, and the bed is a little more than half as thick as it is where the coal is bituminous. Not enough is known at present to state whether the change takes place gradually, or whether there is a relatively sharp line of demarcation between the two kinds of coal. There is a somewhat widespread belief that the nearer a large body of intrusive igneous rock approaches a bed of coal, the greater will be its degree of anthracitization. Although this may be true in general, the analyses of the Cerrillos coals do not seem to bear it out. In Anthracite Mine No. 1, where the igneous rock is several feet above the coal, there is relatively little volatile matter in the coal, but in Anthracite Mine No. 4, where the igneous rock is separated from the coal by only a few inches of shale, there is more than three times as much volatile matter. The anthracitization of the coal has been very generally attributed to the heat from the igneous rock. It seems possible that the influence of the heat may have been overestimated and that other causes, as, for example, pressure due to lateral thrust during the mountain-making epochs that warped and tilted the rocks, may have contributed towards the change. However, this pressure was not the only cause, as is shown by the fact that the coals now below the White Ash, although subjected to the same movement, were not changed to anthracite."

The Albuquerque & Cerrillos Coal Company operates five mines at Madrid: Nos. 4, 8, and 33 in the anthracite vein, and the Jones and Lamb mines in the bi-



TYPICAL DISPLAYS

The figures at the top left are much larger than life size and are placed on a mountaintop, with floodlights playing on them. The set just above is in a miner's home. The other picture shows a Catholic church.

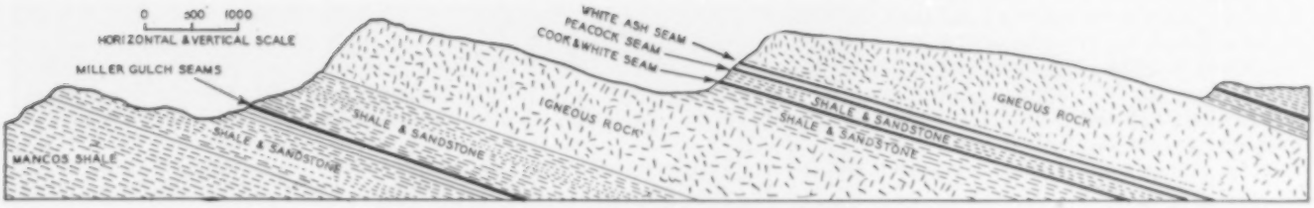
tuminous. About 30,000 tons of anthracite and 100,000 tons of bituminous are produced annually, the output going to Kansas, Nebraska, Oklahoma, Texas, Colorado, Arizona, New Mexico, and California mostly for commercial purposes. The anthracite is prepared in a breaker that was built in 1893, and the spiral method of cleaning is used. The coal is prepared in sizes ranging from lump to pea in bituminous, and from lump to buckwheat in anthracite.

Both the anthracite and bituminous mines are worked on the modified long-wall or double-room system, dip entries being turned off from the slope and rooms opened from them across the pitch. The top is solid sandstone, and few timbers are required. The workings are comparatively dry, and the little water that is pumped out is treated and used in the boilers. All haulage underground is with ropes, the miners pushing their cars out to the dip entry, where they are picked up by the rope. Outside haulage to the tipples is done with electric locomotives. The power plant consists of one main 1,250-kva. turbine-generator and two auxiliary units of 750 kva. each. Three boilers are in operation, all hand-fired with slack. The company has its own locomotive and 3 miles of track reaching to the main line of the Atchison, Topeka & Sante Fe Railway at Waldo. The miners are all paid on a tonnage basis; but dips are contracted to various men who assume responsibility for getting out the coal and who are paid according to the tonnage they produce. The hiring of all workers is done by the company.

The Town of Madrid lies off the main highway about 50 miles northeast of Albuquerque and is entirely company-owned. The homes are mainly of the regular coal-camp type, with a few better residences along the main street. Each is supplied with electricity which is included in the rental, together with coal and water. The latter is hauled in tank cars from Waldo; and about 125,000 gallons are required daily for domestic purposes. Practically every business house in the community—a picture show, beauty parlor, pool hall, restaurant, hotel, filling station, and a large general store where every kind of merchandise can be purchased—is controlled by the company.

Madrid has another distinction that has nothing to do with the freakish feature of its coal beds. For eleven months of the year it is just another coal camp, with sprawling houses strung along the side of a canyon. Coal dust eddies around the grimy anthracite breaker and lies heavy on porch and roof. The dinky engine puffs back and forth between Waldo and the mines. Rope trips roar over the knuckle, land on top, and go back down again. Then, suddenly, it is December, and the drab town becomes a sparkling bit of fairyland set down in sullen hills. Her crooked main street becomes a crowded thoroughfare, echoing with the footsteps of alien feet and warm with the glow from thousands of winking lights. A steady stream of automobiles crawls along the floor of the canyon, and across the frosty air comes the sound of carols telling the old, old story of the Babe in the Manger. For it is Christmastime in Madrid and the Madrid lights are lit!

There is a story behind the Madrid lights. When a dowdy little coal camp can draw visitors by the thousands every year, there must be a story! The mammoth spectacle that is now an annual event in the town did not happen overnight. It had its origin fifteen or sixteen years ago among a group of individuals who were in the habit of setting up a Christmas tree and decorating their homes during the holiday season. At that time there was no organized effort; but each family hung greens and ornaments for its own pleasure. In a year or so the Madrid people began to realize that their little community had more than the usual number of decorated homes, and someone suggested the forming of a club for the purpose of doing the job as a community project. Part of the plan was a huge community Christmas tree, where each child was to receive a gift from the club. Because they all worked for the



SECTION THROUGH CERRILLOS COAL FIELD

The Cook and White seam is a 4-foot layer of coking bituminous coal. Seventy-five feet and more above it is the anthracite vein. In few if any other places could these two kinds of coal be mined from one entry.

same company, they decided to name their organization The Employee's Club.

The idea grew and the Christmas lights grew; and to finance the undertaking there was adopted a check-off system operated through the company office whereby each worker contributes a certain sum each month, the amount running not more than 75 cents. The money is used for the purchase of materials necessary for the sets, while the actual labor of placing them, stringing wire, and getting everything ready is donated by the miners, who devote evenings and Sundays to this job. And so the Madrid lights have grown from year to year into a gigantic community celebration that draws people from distant places.

The visitor to Madrid during the Christmas season will find himself driving across black and frowning hills, through winding canyons, and into a land where the nights are black and cold. As his car sweeps onward, its lights stabbing the darkness, it will top the last long hill, swing around a bend, and lo, before him he will see a magic city nestling below. On entering the town a blazing archway gives him welcome. No house is so humble that it does not support a gleaming Christmas tree. Gay with lights are the doorways, wide flung are the shades on every window, and within is a Christmas scene. Across the way, on the side of a frowning mountain, Mary and Joseph, life size, trudge along the path to Bethlehem. High on the mountaintop are the angels who guided the Wise Men; and from somewhere in the background comes the music of a heavenly choir.

As his car crawls along the narrow roadway leading to the main street, the traveler begins to feel that he is entering a holy place. Along the streets are no hot-dog stands, no noisy peddlers of souvenirs, no blaring of a radio tuned to a swing band. The crowds on foot move along with quiet step, drift into the byways or stand silently before some unusual display. No attempt is made to commercialize this show of shows. Madrid has nothing to sell to tourists. There is no charge for the beauty created there.

It is no small task for the miners to erect the sets, hang the decorations, and bring in and trim the hundreds of Christmas trees. Preparations begin early in October, when each idle day sees the men busy on the mountainsides stringing wires, placing sets, and getting ready for the big event. As the day for turning on the lights approaches, the women and children enter the picture. Individual trees and displays begin to take shape in the homes, where all is hustle and bustle, for this is Madrid's big moment, the eve of a spectacle unlike any other elsewhere in the United States.

All the work is contributed by the miners, with one exception. For the past three years the Employee's Club has engaged Pierre Menager, well-known Santa Fe artist, to paint the scenes for many of the sets. Some of them are gigantic affairs placed high on the mountains overlooking the town. For two or three months out of every year Pierre is busy painting from dawn to dusk. His studio is a vacant building with yawning doors, although much of his work is necessarily done in the open because of the size of the sets.

Some idea of the magnitude of this undertaking may be gained from a few figures. More than 40,000 light bulbs are used, ranging from small Christmas-tree globes to mammoth 1,500-watt floodlights costing $5 to $20 each. The power they consume would run close to $10,000 if it were purchased at commercial rates. Two carloads of 2x4-foot stringers, more than 34,000 square feet of hard board, and 75 gallons of paint are about the yearly requirements for the building of sets. And the estimated investment of the miners in equipment for their annual show would run close to $50,000. The Madrid lights are turned on early in December and cast their refulgence each night for about a month.

The Employee's Club is interested in other civic projects. Recently it helped to sponsor the construction of a new school house which was completed last year at an expenditure of about $40,000. It is built of native stone quarried in the nearby hills. Among its other activities is an annual Easter-egg hunt to which every child in the village is invited. Thousands of gaily colored eggs are used; and the program includes sports such as softball, tennis, and baseball which are played in its own park. On July 4, Madrid enjoys a real old-fashioned celebration winding up in a street dance, all arranged by the Employee's Club. But all these are dwarfed by the festivities in December when the spirit of Christmas glorifies the canyon.

COAL BREAKER AND HOME

The anthracite breaker was constructed in 1893 and has been used ever since. This picture was taken on October 11 of this year and it will be observed that a Christmas set was already being built on the hilltop in the background. The upper view shows a typical miner's home. Note the frames for Christmas decorations along the eaves of the roof.

Overcoming Underground Difficulties

Aqueduct Contractor Wins Battle With Water and Gas

*Fred W. Stiefel**

Photos by John A. Davis

THE difficulties mastered in driving more than 75,000 linear feet of pressure tunnel in deep rock for the Delaware Aqueduct should make the work done under Contract 313 of special interest to engineers and contractors. Nearly one-third of the 44.6 miles of tunnel between the Rondout Reservoir and the West Branch Reservoir is covered by this contract, which was awarded on February 20, 1939, by the Board of Water Supply of New York City to Samuel R. Rosoff, Ltd., whose low bid was $18,916,650. The tunnel line extends from Wawarsing in Rondout Valley to Gardiner in the Wallkill River Valley, and passes at midlength under a spur of the Shawangunk Range of the Catskill System. Unstable and popping rock gave considerable trouble; but the job was made more difficult by the repeated tapping of explosive methane gas and the striking in one area of large volumes of water.

Prior to awarding the contract, the Board of Water Supply had had sunk three shafts on the line of the projected tunnel section. From north to south they are Shafts 2, 2A, and 3. They are a little less than 5 miles apart, and served Samuel R. Rosoff, Ltd., as starting points for driving six headings—three northward and three southward. Shaft 2 is 825 feet deep and is alongside Vernooy Creek, in Rondout Valley, west of the Shawangunk Range. Shaft 2A, high on the west shoulder of that range, goes down 1,551 feet. It is the deepest of all the aqueduct shafts and will be used as a surge chamber to relieve the tunnel from disruptive forces. Shaft 3 is near the eastern foot of the same spur and is 840 feet deep.

Before underground work could be started, the contractor had to unwater the shafts and equip them for service. Shaft 2A presented the biggest problem because of its depth and because the ground water had risen up to within 35 feet of the collar. Unwatering was started on July 18, 1939. A steel-tank float carrying two Ingersoll-Rand Motorpumps, each capable of lifting 100 gpm. at a maximum head of 520 feet, was lowered into the shaft. The tank, 6 feet deep and 8x10 feet in plan, had rounded corners and side and bottom fenders to keep it from catching on the walls as the surface of the water fell during pumping. Two more pumps of the same capacity and make were stationed at three levels in the shaft where the concrete lining had been recessed to receive them. These acted as boosters, taking the discharge from the floating pumps as they settled below them and, in turn, discharging into a service pipe leading to the surface. At the ground level the flow was transmitted to a measuring weir.

In the concrete lining of each shaft are embedded ten galvanized-steel pipes from 1 inch to 6 inches in diameter for feed water, tunnel drainage, compressed air, electric power lines, and telephone circuits, and leading down from the surface outside the lining are two ventilating pipes, one 28 inches in diameter and the other rectangular in section and measuring 21x30 inches. In addition, safety ladders with platforms every 20 feet extend from top to bottom. At the ground level, both ventilating pipes connect with a blower plant consisting of two Ingersoll-Rand Motorblowers, each with a rated output of 11,330 cfm. and driven by a 100-hp. motor. Normally, one blower served to

*Chief engineer and manager, Samuel R. Rosoff, Ltd.

ventilate a heading; but it was possible to switch either blower to either heading, or, in an emergency, to use both to ventilate a single heading. On all other tunnel contracts of the Delaware Aqueduct the blowers have drawn in surface air and discharged it underground near the headings; but from the very start of operations under Contract 313 the blowers have operated in reverse—drawing air from the headings and exhausting it above ground. This was deemed by recognized experts to be the surest way of rapidly disposing of the explosive gas encountered by the tunnelers.

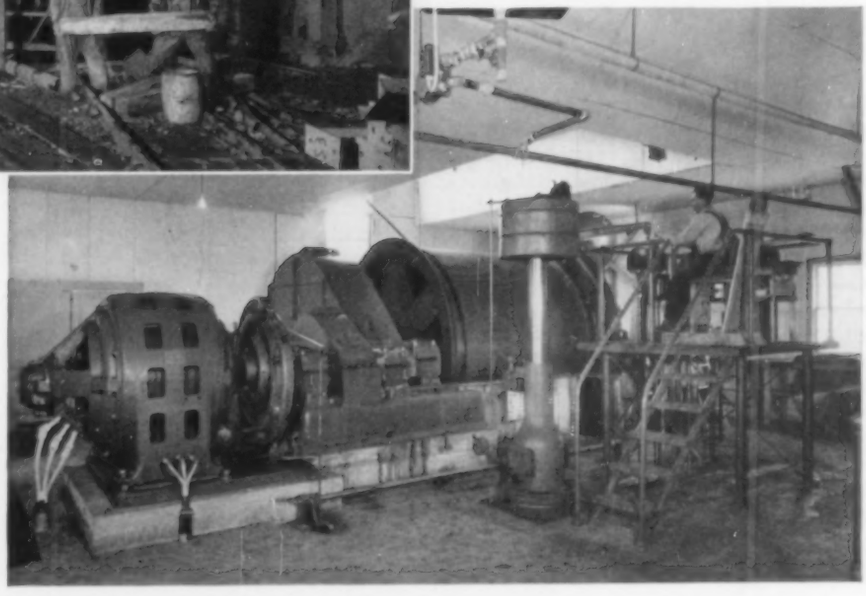
Each shaft has a high steel headframe equipped with two hoist cages and two 7-yard skips arranged in counterbalance and handled by a single-drum Ottumwa hoist. At Shafts 2 and 3 the hoists are driven by 500-hp. motors and the rope speed is 750 feet a minute: at deep Shaft 2A there is a 700-hp. motor and the rope speed is 1,000 feet a minute. Each hoist is provided with approved safety apparatus which are tested every three months. There are "teletalk" connections between the hoist house and the men stationed at the top and bottom of the shaft; and telephone service, which was maintained between the headings and the bottom of the associate shaft, provides communication in the tunnel, while an extension carried up to the switchboard of the local office is hooked up with the public-service-company's telephone line. In addition to the ventilating blowers and hoists, the surface plant at each shaft includes a compressor house with three motor-driven units, each of 1,300-cfm. capacity, to furnish air for rock drills, sump pumps, and other pneumatic equipment, a change house for 240 workmen, a clinic, a blacksmith shop with facilities for shanking and sharpening drill steels, a drill-doctor shop, a storehouse, an office, and a lunchroom.

All excavated rock was hoisted in self-dumping skips that discharged into a 50-yard bin on each headframe from which it dropped through a pneumatically operated gate into motor trucks for disposal. Drill steels were raised and lowered in a compartment car built for the purpose, and dynamite and exploders were carried down in a special powder car. Steel lagging, collar braces, railroad ties, and other lumber have been sent below on flat cars, and rails and the like by underslinging them beneath the skips.

Operating current reaches each shaft head at 66,000 volts over transmission lines of the Central Hudson Light & Power Company. It is stepped down at the surface to 2,400 volts, and transformers near the bottom of the shaft step it down to the 440, 220, and 110 volts required for different services. A dry-type transformer, which was kept not more than 1,000 feet back from a heading, furnished current of 440 volts for each mucking machine. The tunnel is lighted by 50-watt incandescent lamps spaced 20 feet apart. During excavating they were carried to a point about 100 feet back from a heading where Crouse-Hinds explosion-proof floodlights provided illumination.

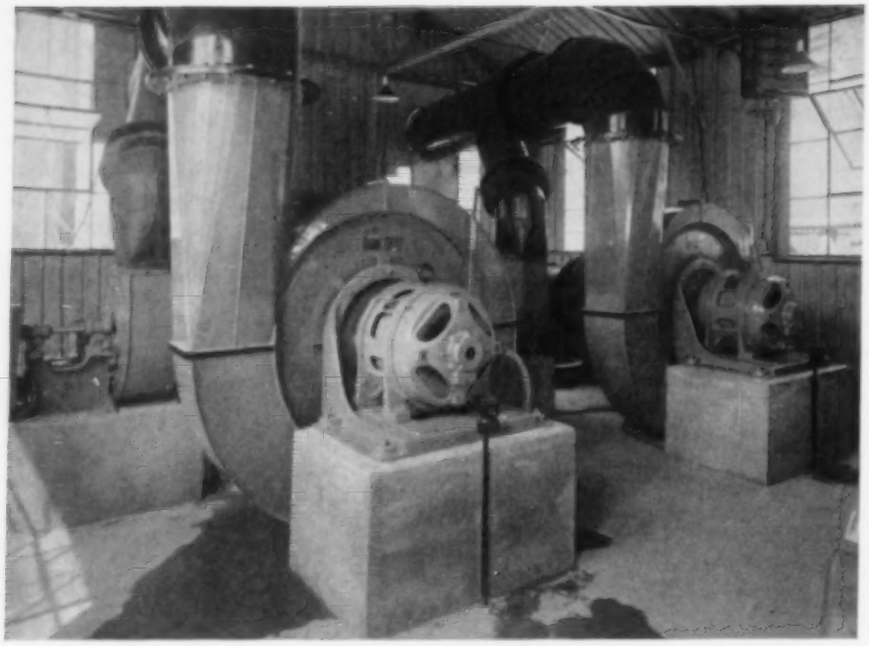
Stub-tunnel sections that had been driven under the shaft-sinking contract were widened out by Samuel R. Rosoff, Ltd., to a maximum diameter of 40 feet and extended along the tunnel line for 100 feet in both directions from a shaft. Each of these bell-shaped chambers has afforded space for tracks on opposite sides of the skip pockets—one leading to rotary dumpers and the other to a turntable connecting with a transverse stub track that can be run to the center of the shaft bottom for unloading materials arriving in cars or slung beneath a skip. A side drift, a short distance from the shaft bottom, has served as a chamber for the main drainage pumps; and a stub siding, 300 feet from the shaft and extending toward each heading, has been used as a battery-charging station. Five battery locomotives were assigned to each shaft for the main-line run, for switching, and for service at the rotary dumpers.

The main-tunnel track is a single line of 36-inch gauge; and during excavating, the track toward each heading had sidings 180 feet long with turnouts. The rolling stock at each shaft has consisted of 60 muck cars and twenty 6-ton flat cars, together with three drill-steel cars and two powder cars. The muck cars, designed by the contractor, have solid steel bodies



HOISTING OPERATIONS

The contractor worked through three shafts, opening tunnel headings in two directions from the bottom of each one. Over each was erected a steel headframe, the one shown on the facing page being at Shaft 2. At the right is a single-drum electric hoist installed in one of these headframes for raising and lowering the counterbalanced skips and cages. Above is pictured the bottom of a shaft where the tunnel section was widened to about 40 feet to provide room for handling muck and materials.



VENTILATING BLOWERS

Two Ingersoll-Rand Type FS-575 Motorblowers, each rated at 11,330 cfm. and driven by a 100-hp. motor, were installed at the top of each shaft. Ordinarily, one unit served one of the two headings opened from each shaft bottom. To cope with the gaseous air encountered, the blowers operated as exhausters, drawing the vitiated atmosphere out through piping extending from all drilling faces along the tunnel sections and up the shafts. On one occasion, when an exceptionally heavy flow of methane was released during excavating, one of the blowers was moved down into the tunnel to serve as a booster. Suction fans, one on each drill carriage, also helped to draw the gas away from the faces before it could mix with air to form an explosive.

with a water-level capacity of 6 cubic yards, are fitted with special safety couplings, and are equipped to engage rotary dumpers. Except north from Shaft 2, where the 12,000-foot stretch has an upgrade of 2.31 per cent, the tunnel section under this contract is generally level. On the latter runs, loaded trains were made up of eight cars: on the climb of five cars. Eight-car trains moved 8 miles an hour when loaded and 12 miles an hour when empty. The 5-car trains coasted down to the shaft when loaded and averaged 5 miles an hour when returning empty to the heading.

Most of the tunnel lies about 400 feet below sea level, and the rock encountered under Contract 313 consisted mainly of shales and sandstones of varying hardness and abrasiveness. The bedding was generally horizontal, except through 500 feet of water-bearing faulted zone south from Shaft 2. Tunnel driving at each heading was done by six wet-type 3½-inch drills mounted at the forward end of a collapsible drill carriage. Drill steels had a maximum length of 15 feet, and 2-foot changes were used. From 40 to 50 holes were put in each round.

With a round completed, electric current was cut off at a point 1,500 feet back from the face and the holes were loaded from the drill carriage—electric cap lamps providing illumination. An average of 4 pounds of Atlas 40 per cent dynamite was used per cubic yard of rock, and firing was done with 0 to No. 6 delay, shunted exploders in safety primers. Just before the heading crew retired, an air-water spray was put in action about 60 feet back from the face. This helped to lay dust and to reduce any concentration of toxic gases, while the exhaust system of ventilation effectively removed explosion fumes within ten minutes after shooting.

The fire boss was the first one to return to the heading; and when he found everything favorable after making tests with a flame safety lamp and a toxic gas detector, he allowed the heading crew to return. The men moved in with a 75-hp. Conway mucker that they had parked on the nearest siding, and this machine cleaned up fly rock and then attacked the main muck pile. At the same time, safety miners scaled the roof and the face; and, where necessary, a number of 15-foot crown bars with blocking was erected to maintain the roof. This work was done from the top of the muck pile.

To keep the mucking machine operating efficiently, an empty car had to be placed at the discharge end as soon as a full one was removed. This was done by a simple form of "cherry picker" that lifted an empty from the rear of the train, held it aloft while the train backed, and then set it on to the track in front of the train where it could be pushed into loading position. With the last car loaded, the locomotive found itself heading toward instead of away from the shaft. The cherry picker was in the form of a block attached either to the steel roof support or to an expansion bolt anchored in the sound rock and used a 5-part line with a single line leading to an Ingersoll-Rand pneumatic hoist secured to the side wall of the tunnel. The hoist line carried a 2-part bridle with hooks to engage rings—one at the center and one at each end—inside a car. There were two cherry pickers a little way apart at each working face, and they were alternately shifted forward as the heading advanced.

In the center of each drill carriage was a Roto-Clone blower, with a capacity of 8,000 cfm., which drew air from the heading at two points through steel suction intakes each 8 inches by 5 feet in cross section. The intakes, one at the top and the other near the bottom of the jumbo, were about 3 feet from the face, and the blower discharged through a 16-inch collapsible vent tube that exhausted directly into the regular 28-inch main vent pipe which had its intake within 80 feet of the face. The Roto-Clone blowers were used primarily to withdraw methane gas released by rock drilling.

On August 23, 1938, when Shaft 2A was being sunk and a stub-tunnel section was being driven northward under an earlier contract, drilling suddenly released methane gas. The explosion which followed burned all the eighteen men in the tunnel to some extent and critically injured one of them. A representative of the U.S. Bureau of Mines, reporting upon the mishap, stated that, to safeguard the workmen, it would be necessary to provide sufficient ventilation to diffuse the liberated gas so that the tunnel atmosphere would not contain more than 0.25 per cent of methane—preferably less. It was further recommended that all electrical equipment be of the permissible type, and that bare flames or sparks should be guarded against.

Methane gas was struck at Shaft 2A shortly after the north and south headings were started by Samuel R. Rosoff, Ltd., and later at the north heading from Shaft 3. When the north heading from Shaft 2A had been advanced about 2 miles, an exceptionally heavy gas escape was encountered. To meet that situation, one of the large 11,330-cfm. blowers was moved down into the tunnel and set up 12,000 feet from the shaft. The combined effect of the surface blower, of the large booster blower, and of the Roto-Clone fan was to draw the vitiated air from the face so quickly that the methane gas could not form an explosive mixture.

At Shaft 2A there are two 5,000-cfm. blowers, each driven by a 10-hp. motor. These are standby units and are used for underground ventilation only when work is suspended. They serve to prevent the accumulation of an explosive mixture of methane gas that might occur in as brief

a period as three hours—the gas rising to the roof of the tunnel and gradually spreading longitudinally. No gas explosions have occurred during the work on Contract 313, and the U.S. Bureau of Mines has commented on that fact and pointed out that, because of this success, the performance may not get the recognition it deserves.

The technicists of the U.S. Bureau of Mines remarked upon the absence of fog and fumes in the tunnel sections during excavating, the excellent visibility, and the invigorating quality of the air moving steadily along. Keeping the atmosphere clean in a tunnel of this kind, even with wet drills, is something of a problem, because the transportation of materials and other operations stir up dust already deposited on rock surfaces, while mucking, guniting, and other work increase the amount of dust floating in the air. Notwithstanding all the dust in the ambient air, the blowers used on Contract 313, according to the Federal inspectors, kept the atmosphere in an excellent condition.

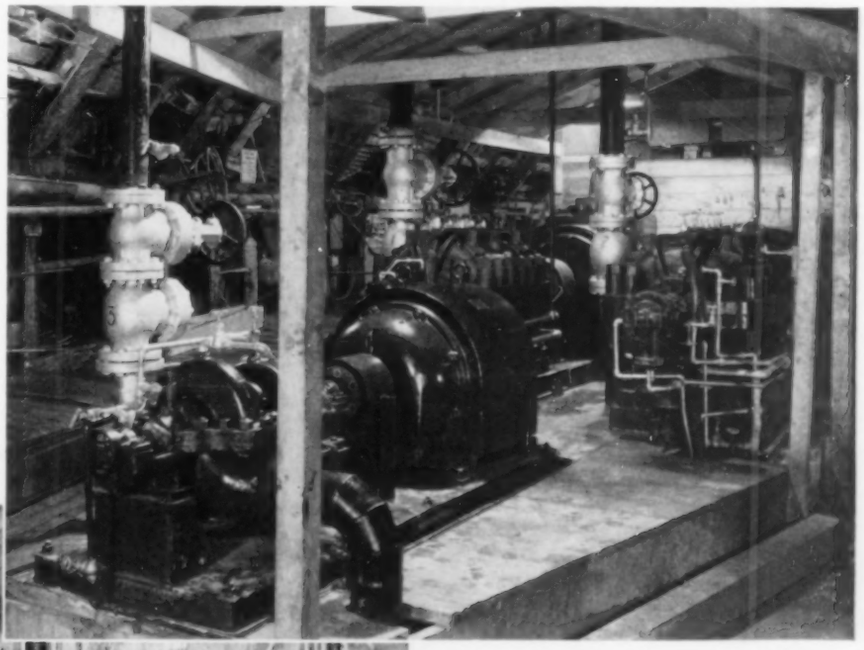
Because of difficulties encountered in this stretch of the Rondout-West Branch Tunnel, 89 per cent of it has required support. With this fact in mind, it may be of interest to cite what was accomplished at six headings in 31 working days—from May 3 to June 8, 1940. In that period was excavated 6,500 feet of tunnel having fully supported sections. At the contract price, that was equivalent to earning $1,167,400, or 10,075 feet of unsupported tunnel would have had to be driven to earn the same sum.

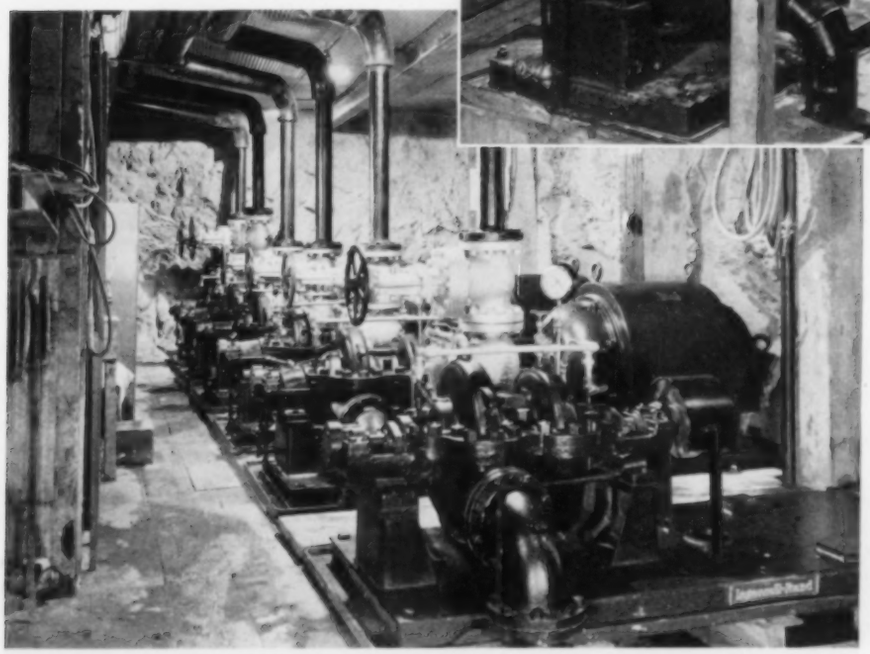
The finished diameter of the tunnel, lined, will be 13½ feet; but the excavation in the rock section generally ranged from 17 to 19 feet in diameter, and in one stretch of several hundred feet it reached 24 feet. Usually, a round of drilling, blasting, and mucking took three hours or less, permitting the removal of eight to nine rounds in a 24-hour day with three shifts. This was done while working by the independent method: by the alternate method—shifting a crew from one heading to another—from six to seven rounds were completed in 24 hours. The pull at each round amounted to 10 to 12 feet.

In addition to tapping methane gas, the heavy squeezing ground under the Shawangunk Range caused much popping rock, necessitating the use in long stretches of 6-inch, 18-pound, steel H-beams for crown-bar protection at the face and of steel roof support consisting of wall plates on which were erected on 4-foot centers suitably braced 6-inch, H-section, 27½-pound ribs. All told, about 40,000,000 pounds of structural steel—equivalent to 550-600 pounds per linear foot of tunnel—was placed, and some 1,120,000 board feet of lumber blocking was required. To minimize air slaking, extensive expanses of the roof and walls beneath wall plates were gunited. Little difficulty was experienced with water except in driving the heading south from Shaft 2, where the tunnel lies 650 feet below Rondout Creek. There a hard battle was fought.

Rondout Gorge, in the vicinity of Shaft 3, is approximately 3,000 feet wide, and the bed of Rondout Creek is made up of glacial drift that has a vertical thickness to ledge rock of more than 400 feet. In that area the rock cover of the tunnel has a minimum thickness of 260 feet, which would be ample if the rock were sound. The glacial drift is inundated with water from Rondout Creek and tributary Vernooy Creek. Tunnel driving from Shaft 2 southward began September 20, 1939, and the shales and sandstones penetrated gave little trouble during an advance of 6,778 feet.

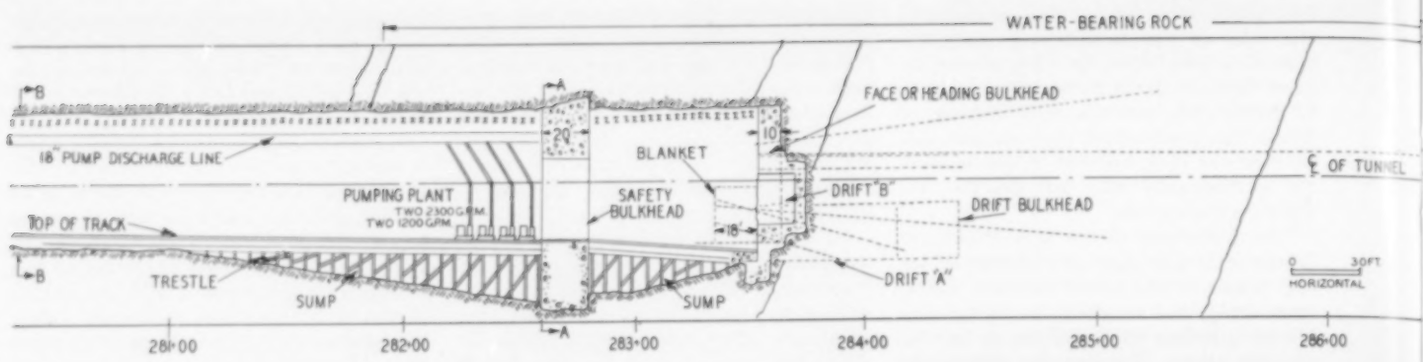
Water-bearing rock was reached when the heading arrived at Station 281+88 on June 18, 1940. Test holes at the face gave a flow of 400 gpm.; but grouting equipment, held in readiness, brought it





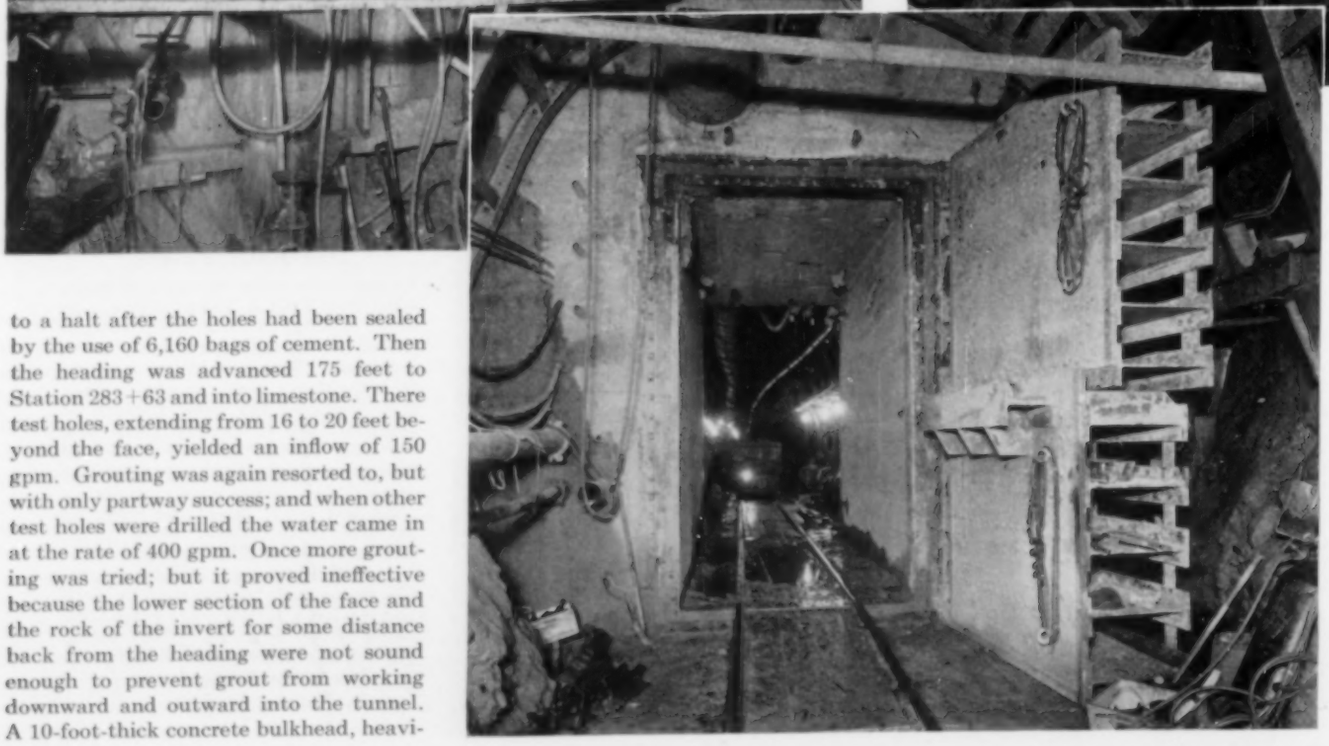
DRAINAGE PUMPS

To handle the water encountered southward from Shaft 2, pumps with a combined capacity of 7,000 gpm. were installed on the tunnel side of the safety bulkhead. Taking suction from a 90,000-gallon sump located there, they delivered the water through an overhead line to another sump near the shaft bottom. At this point nine Cameron pumps, with a combined capacity of 9,550 gpm. against a 1,000-foot head, raised the water up the shaft to the surface. Shown at the left are six No. 4 GT units, each driven by a Westinghouse 350-hp. motor. The three others (above) are a No. 4 GT and two No. 6 HMT's, each of the latter being driven by a G-E 500-hp. motor. The installed horsepower of this pumping plant totaled 3,450.

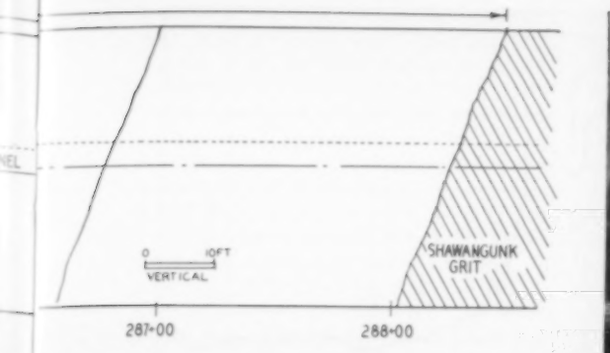


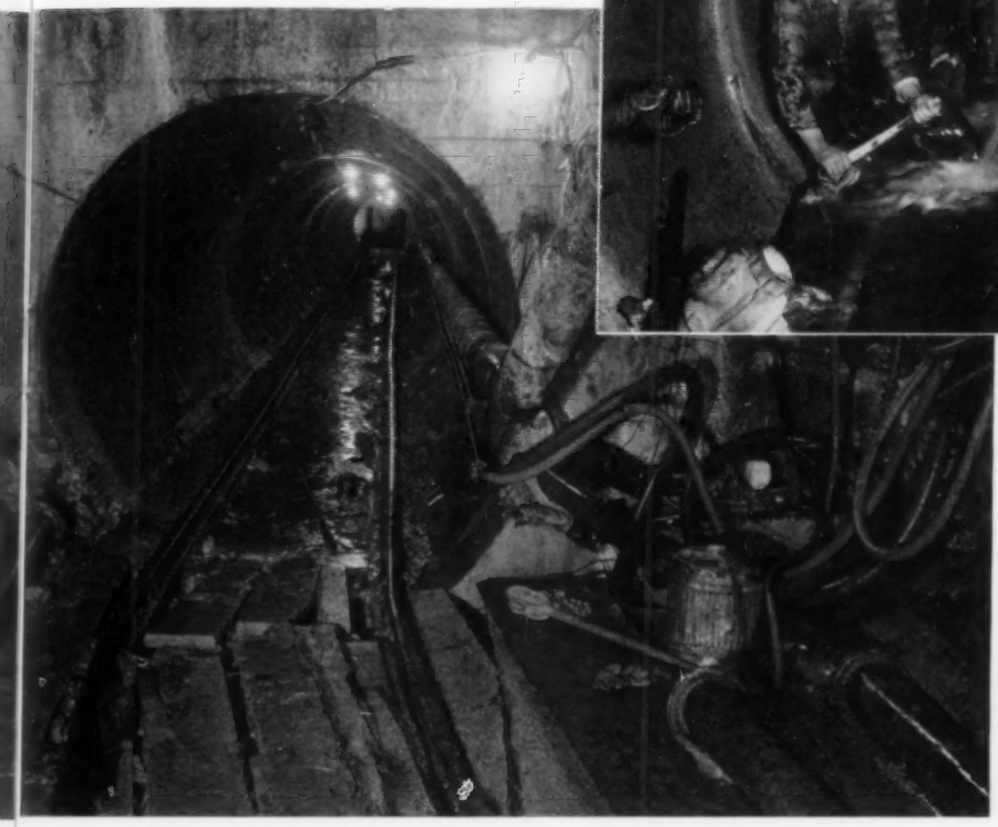
OVERCOMING WATER

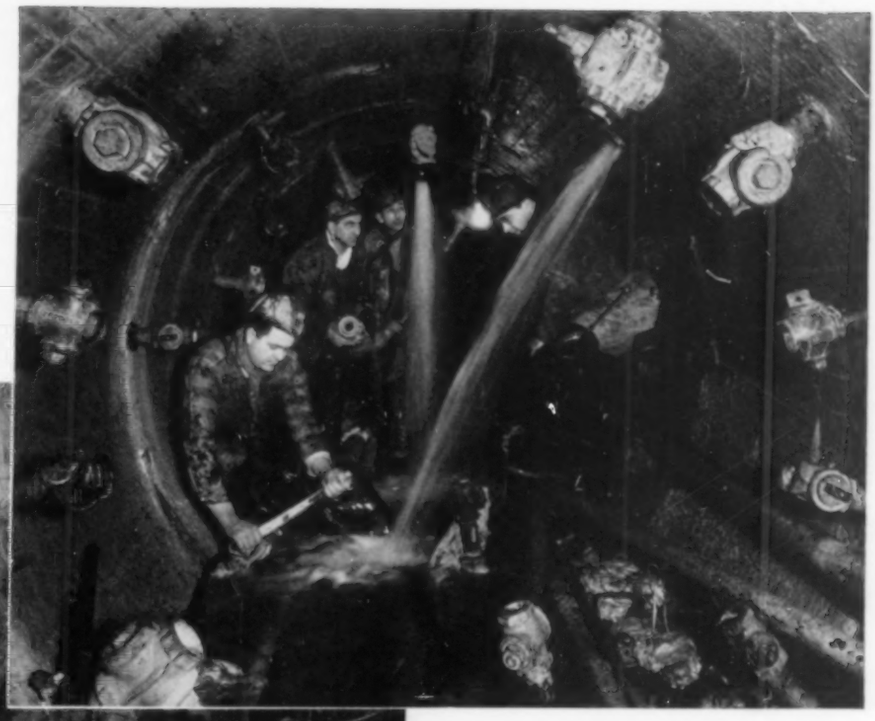
Approximately a year was spent in driving 750 feet of tunnel underneath the valley of Rondout Creek. Water pouring into the workings could not be successfully grouted off until several attempts had been made to control it. The drawing shows the bulkheads erected in the full tunnel section, the course of the grout and of the exploratory holes that were drilled, and the outlines of the two small drifts that were driven from that point. Drift A failed to accomplish its purpose, so it was filled with concrete: Drift B, a circular opening (right) at the center line of the large tunnel section, was encased in concrete 18 inches thick. Grout pipes equipped with valves were embedded in these walls (far right), and through them radially disposed holes were drilled into the surrounding rock. Grout pumped into them sealed off the ground water and enabled the crews to excavate the tunnel to the prescribed diameter. The picture just below shows core drilling through the concrete bulkhead put up at the heading where water temporarily halted progress. At the bottom is one side of the safety bulkhead with its heavy steel door. It was erected 73 feet back from the face.



to a halt after the holes had been sealed by the use of 6,160 bags of cement. Then the heading was advanced 175 feet to Station 283+63 and into limestone. There test holes, extending from 16 to 20 feet beyond the face, yielded an inflow of 150 gpm. Grouting was again resorted to, but with only partway success; and when other test holes were drilled the water came in at the rate of 400 gpm. Once more grouting was tried; but it proved ineffective because the lower section of the face and the rock of the invert for some distance back from the heading were not sound enough to prevent grout from working downward and outward into the tunnel. A 10-foot-thick concrete bulkhead, heavi-







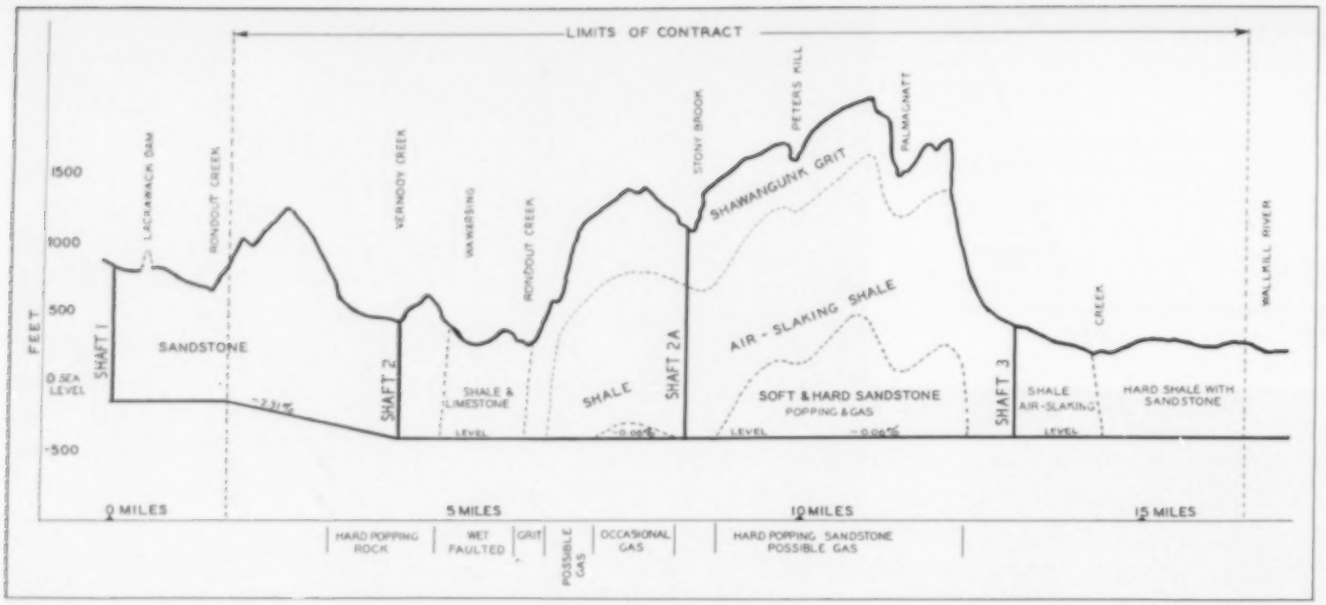
ly reinforced with 60-pound rails set up vertically on 2-foot centers, was then erected against the face. The lower half of the bulkhead was strengthened by an 18-foot concrete blanket or bench the top of which was just below the tunnel springing line. It was reinforced with 60-pound rails laid horizontally on 3-foot centers and keyed to the side walls of the tunnel with 2-inch steel dowels. That blanket sealed the unsound rock of the invert.

Steel pipes, 4 inches in diameter, were embedded in the bulkhead and blanket to serve as casings for core drilling, while other pipes afforded controlled outlets for leakage from the ground behind the bulkhead. Core drilling was done to reveal the nature of the rock ahead and to determine the distance that would have to be covered in the water-bearing formation before reaching Shawangunk grit. The core-drill holes also permitted grouting the water-bearing rock so that the full face could be excavated in advancing. The exploratory work ended October 2, 1940, by which time 3,189 linear feet of core boring had been done and one hole had penetrated to the Shawangunk grit—a distance of more than 500 feet. Afterward, holes totaling 1,392 linear feet were drilled up to a depth of 70 feet, and these were grouted in an effort to consolidate the rock behind and adjacent to the bulkheaded face.

The open 4-inch pipes were used for drilling until the incoming water required the withdrawal of a drill and the fitting of a gate valve on the pipe to shut off the flow. Next, the valve was opened and grout was forced into the hole to refusal. When holes had to be drilled still deeper, it was soon found that those already grouted were preferable for that purpose because the rock around them had been partly consolidated by the material forced into them at a pressure of from 1,000 to 2,000 pounds per square inch. Such re-cored holes admitted less water into the tunnel than nearby newly drilled holes, indicating how restricted laterally was the penetration of the grout into the rock. The recorded static pressure of all the inflowing water was as high as 290 pounds per square inch, showing clearly that the source was Rondout Creek, 650 feet above. Before grouting leakage areas, the flow from some holes was at the rate of 1,000 to 2,000 gpm. The outcome of core drilling and grouting up to the end of the foregoing stages made it plain that some other plan of attack had to be devised, that the rock could not be sealed to the extent desired for driving the entire face.

The rock through which the heading had to be advanced was not just sandstone and shale, but a formation containing limestone beds of different thicknesses, and the limestone was interspersed with solution cavities and seams carrying water. Thin passageways interconnected the cavities, and while water could move through them they offered difficult channels for the introduction of grout. Grouting was done with 10x3x10-inch grout pumps, and the mix contained from 16 to 45 gallons of water per bag of cement. All told, 44,095 bags of cement were forced into the rock prior to the completion of the exploratory work, and 1,838 bags of cement were used in an effort to consolidate the rock around the heading bulkhead and the 18-foot blanket before the core drilling described was begun.

The new line of attack took the form of an 8x8-foot drift driven from the lower left-hand quadrant of the bulkhead after the blanket was removed. Because of the danger that the drift might develop much greater flows of water, the contractor con-



GEOLOGICAL SECTION

Here are shown the tunnel and ground-surface profiles, together with the underground conditions as revealed by preliminary studies and previous aqueduct operations. The heavy influx of water was encountered in the shale and limestone section at the right of Shaft 2 where the tunnel lies 650 feet below Rondout Creek.

structed a 20-foot-thick safety bulkhead 73 feet back from the face to prevent possible flooding of the tunnel. It was needed only once during a temporary shutdown of the pumps when the accumulated water built up sufficient pressure to test it and to disclose leaks that were soon sealed. The bulkhead was securely keyed into sound rock and had a central rectangular passageway 6¼ feet wide and 11⅙ feet high with the sill at the floor level of the tunnel. The passageway was provided at the heading side with a Dutch-type steel door the two sections of which were of massive construction. At the doorway, the 36-inch-gauge track was removable to permit closing the door. Pipes for drainage, compressed air, feed water, and grouting were carried through the bulkhead, as well as the 28-inch vent pipe which was provided with a self-sealing flap valve that would close if pressure developed on the heading side. A sump was excavated on the latter side to take water flowing rapidly from the working-face bulkhead, and a second sump on the tunnel side of the safety bulkhead was made sufficiently large to hold 90,000 gallons of water reaching it from 12-inch discharge pipes connecting with the sump on the opposite side. Pumps placed adjacent to the larger sump had a combined capacity of 7,000 gpm. and discharged into a 16-inch-diameter overhead line running to another sump near the shaft bottom where nine Cameron pumps, with a combined capacity of 9,550 gpm. against a 1,000-foot head, were installed to raise the water to the top of Shaft 2. The main track of the tunnel was supported on trestles over the two sumps, and decking was laid the full width of the tunnel throughout the same area. Finally, with the concrete blanket at the heading bulkhead removed, all was ready for driving the 8x8-foot drift, or Drift A.

Drift A had its axis 4 feet to the left of the tunnel center, and its invert was 11.6 feet below the springing line. At the start, the drift bore slightly toward the left of the center line, but after advancing about 9.5 feet it straightened out and ran parallel with it. The drift was unlined, and little grouting was done prior to penetrating the rock for 87 feet, when leakage aggregated 1,200 gpm. and test drilling disclosed an additional 900 gpm. in the ground ahead. At that point the heading was sealed with a 26-foot bulkhead; and after repeated but unsuccessful efforts to grout the rock back of the face, the work was abandoned and the drift filled solidly with concrete—all grout pipes and drains being carried through the concrete back to the bulkheaded face of the tunnel at Station 283+53. The small drift proved that horizontal drilling and grouting through those holes would not seal the water-bearing rock any better than the holes and grouting from the original point of attack—the bulkhead at the station just mentioned. When Drift A was abandoned, leakage into the tunnel was fully 2,100 gpm., but it could be shut off by closing the valves on the drain pipes. Once more another method had to be devised to deal with the water-bearing rock through which the tunnel had to be advanced.

The contractor decided to drive a second drift from the bulkhead at Station 283+53, with the axis of the drift on the tunnel center line, but 3 feet below the springing line—the drift to slope upward on a 1 per cent grade to promote drainage. Drift B had a 10-foot circular section as excavated and was lined with a minimum of 18 inches of concrete that provided a finished diameter of 7 feet. In the invert were placed two drain pipes, each 12 inches in diameter. The advance 5 feet of the drift was left unlined at each successive halt, and the invert at that point served as a sump for leakage from the face, the water running away through the drain pipes instead of over the concrete of the lined invert. The heading also provided room for placing a bulkhead, if necessary, and space for other operations in connection with exploratory drilling and the advance of the drift. The lining of the barrel drift, as it was called, was tied into the concrete of the heading bulkhead and to the surrounding rock, which was excavated for the purpose. The drift presented a solid concrete barrier, except at the heading, against outlying water. While driving Drift B, a 36-inch-gauge track was laid on the invert of the lining, and all muck was loaded by hand into regular cars cut down to half height to assure clearance.

In the annular wall of the drift were embedded 3-inch pipes radiating toward the outlying rock and arranged in ring formation—fourteen pipes to a ring and rings 4 feet apart. The pipes were used for drilling and grouting the enveloping rock as the drift was advanced. The inner ends of the pipes were fitted with valves for the control of leakage before grouting. The holes were drilled a maximum distance of 10 feet beyond the projected line of the tunnel excavation—that is, for a section 24 feet in diameter. This work was done with two drifters mounted on columns, and 2-foot changes of steel

were used. The longer ones were assembled with Ingersoll-Rand sleeve couplings and carried Jackbits from the same manufacturer.

The invert and arch of the barrel lining were poured separately by the aid of wooden forms. At all construction joints in the lining were interposed 18-inch-wide water stops of ⅛-inch steel plate to prevent the inward leakage of water or grout. Concrete bulkheads were erected at points 20, 77, 111, 160, and 220 feet in from the portal, or whenever too much water was encountered as the drift was advanced. It was driven 226 feet, lined for 220 feet, and closed at the face with a concrete bulkhead 6 feet thick. The work was started December 17, 1940, and was finished on March 27, 1941.

High-early-strength cement, containing 2 per cent by weight of calcium chloride, was used for lining the drift. The grout was made of the same cement with from 16 to 45 gallons of water per bag of cement. This mix was air agitated and was forced into the rock at a maximum pressure of 2,000 pounds per square inch. Before grout was injected the rock was flushed with water at a pressure of 2,000 pounds to remove as much as possible of the fine material to clear the passages in the rock for the infiltration of the grout.

Radial grouting and high-early-strength-cement grout won the battle. Ordinary cement gives a set volume of 50 per cent, while that of the former is 90 per cent. It was this difference that largely enabled the contractor to seal and to consolidate the water-bearing rock. The maximum inflow of water at the heading south from Shaft 2 was 2,000 gpm. But for the results obtained by the barrel drift the leakage probably would have amounted to 40,000 to 50,000 gpm. Under the schedule, the excavating of the 75,000 feet of tunnel was to be completed in four years. However, even though he was slowed up for a whole year by the troublesome section south from Shaft 2, the contractor finished this work in virtually two years and two months.

The enlargement of the tunnel section for a distance of 750 feet through the difficult stretch just mentioned to 24 feet by the full-face method was to afford space for a 1-inch steel interlining and the placing outside of that shell of a reinforced-concrete backing, averaging 3 feet in thickness, in contact with the rock. The interlining will require 937 tons of plating, and 313 tons of twisted 1¾-inch square bars will be used to reinforce the concrete.

The tunnel sections driven from Shaft 3 are now being lined. The invert is placed at an average rate of 505 feet in an 8-hour shift, and the arch at an average rate of 460 linear feet a day. This work is done in four stages: first, concrete curbs are poured at opposite sides of the invert, and on these are laid wide-gauge tracks for the mobile platform required for placing the invert; next, the muck is removed from the tunnel floor with a bulldozer and a drag-line excavator; and then the invert is poured. The mobile bridges used vary in length from 700 to 1,100 feet, and each carries a main track of 3-foot gauge and a switch long enough to permit concrete trains moving to and from the shaft to pass each other. The screed for forming the invert section is drawn by an Ingersoll-Rand hoist, of 6,000-pound cable-pull capacity, using a single line. The same hoist, but with a 2-part line, serves to shift the bridge, which weighs more than 15,000 pounds when carrying forms. Blaw-Knox collapsible forms are employed for the arch; and the concrete is delivered behind them by two 1-yard Pressweld pneumatic placers operated with air at a pressure of 90 to 100 pounds per square inch.

At Shaft 3 the surface concrete batching and mixing plants are, in principle, typical of those to be used at the two other shafts. The batching plant is of the Blaw-Knox type and is mounted on an elevated steel framework. Cement, sand, gravel, and water are fed by gravity through pneumatically controlled supply lines to three 1-yard Ransome mixers directly below on the ground. Batching is done in eighteen seconds, and mixing takes one minute. The concrete is discharged into a 12-inch drop pipe that carries it down the shaft to a hopper from which it is dumped into 5-yard Blaw-Knox agitator cars. The mixers discharge successively at 30-second intervals, and a train, consisting of four cars, can be loaded in ten minutes. Just before a car dumps into the invert form or into one of the pneumatic placers, the agitator is revolved, a power line being tapped for the electric current.

To make every minute count, the trains are hauled by 160-hp. Whitcomb diesel locomotives of which there are five in service. Each has a running speed of 20 miles an hour, and the trains are hauled at the rate of 12 to 15 miles, over-all time. The diesels have greater speed and cost less to operate and maintain than the storage-battery locomotives that have been employed for other work on the contract. Permission to use the type underground—previously prohibited—was granted by the New York State Department of Labor because of the proved effectiveness of the tunnel ventilating system developed by the contractor.

Sand and gravel for all concreting on the job is obtained from a conveniently located deposit of glacial till where the contractor has an up-to-date crushing and washing plant capable of turning out 150 tons of sand and gravel an hour.

The Board of Water Supply is represented in connection with Contract 313 by Charles M. Clark, chief engineer; Roger W. Armstrong, deputy chief engineer; Neil C. Holdredge, department engineer; and O'Kelly W. Myers, senior division engineer. On the job for the Board are Max F. Freund, division engineer; John G. Mergott, Roderic C. St.Leger, and Francis J. Colgan, assistant engineers; John Horn, senior section engineer; and Arthur E. Hilliard, section engineer. The operating staff of Samuel R. Rosoff, Ltd., is made up of Arthur H. Diamant, vice president; the author, manager and chief engineer; James Fisher, general superintendent; David E. Stinson, general master mechanic; Philip S. Miller, first assistant engineer; W. Quick, superintendent Shaft 2A; L.S. Penland, superintendent Shaft 2; Walter Dunham, superintendent Shaft 3; and Claude Young, safety engineer.

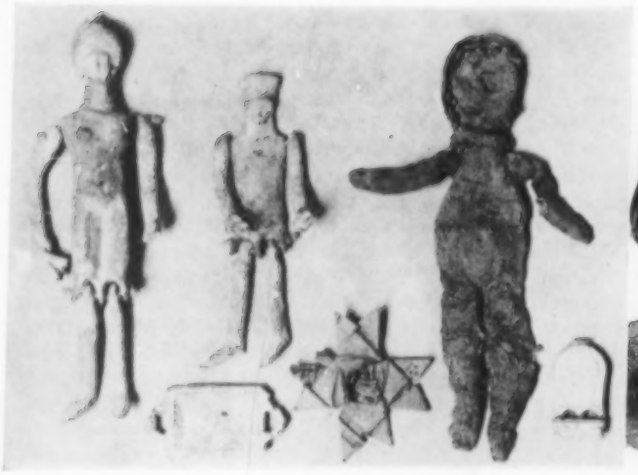
CHERRY PICKER

To shift empty cars to the head of a muck train the contractor used the simple form of cherry picker shown here. A cable, passing over a block secured to the overhead steel or to the rock roof, lifted and held an empty by means of an Ingersoll-Rand air hoist while the muck train of which it formed a part passed underneath it.

Toys of All Times

Anna Dickerman

From the British Museum



TOYS OF FORMER AGES

Dolls, a doll's tray, a kindergarten mat, and a whistle with which Greek and Roman children played 2,000 or more years ago appear above. At the right is reproduced a print from the Louvre in Paris showing eighteenth century French toys. Godey's Lady's Book, published in 1850, illustrated some of the playthings of that time (lower right).

NOT so many years ago, in the ancient turreted City of Nuremberg, a small army of toymakers busied themselves the year round in turning out delightful hand-carved blocks and wooden playthings, without which Christmas on two continents would not have been complete. No dolls could compare with the blue-eyed, blonde-haired German product. The well-dressed Christmas tree wore German glass-blown ornaments in profusion that was limited only by the state of one's pocketbook. The lively tales of the Brothers Grimm were as popular in America as in the land of their origin. The German people were like storybook folk, jolly, kind, friendly, likeable. Now the men no longer are adept at their fascinating craft, for the machine age has dispelled the enchantment which was Nuremberg's. American-made dolls differ from one another in appearance almost as much as do their little owners. Christmas-tree baubles not half so fragile and even more pleasing have taken the place of the imported ones. Grimm's fairy tales are little more than a remembered name. The old order changeth in nothing more than in toys; and the past 50 years have seen greater developments along this line than in all time previously.

There are around 100,000 different kinds of toys, and less than 5 per cent come from overseas. More than 235,000,000 are carried in Christmas stocks in the United States where the trade exceeds $240,000,000 annually. Little Americans play with 50,000,000 streamlined automobiles. Among recent playthings of unusual interest are trains with station announcements, kitchen sinks with running water, electric ranges, doctors' kits with tiny instruments, trimotored planes that will fly for ten minutes, electric kilns that develop temperatures up to 2,000°F. and bake tiny dishes and ornaments molded of clay, doll houses with doorbells and electric lights, washing machines and ironers, dolls that can eat and have beating hearts, and even special concrete and molds to encourage a child to build his own toys. As an aid to geography, there is a Map Rug made of linoleum—a pictorial map of the United States showing the capital, principal cities, and industries of each state. The border depicts the history and development of transportation on land and sea and in the air.

There are more than 1,000 toy manufacturers in the United States of whom half account for some 95 per cent of the output. They have their own trade organ-

ization, the Toy Manufacturers Association of the U.S.A., with headquarters in New York City, where a large permanent exhibition is maintained. Every spring the member concerns hold a Toy Fair in New York and to it come buyers from the world over to place their orders for the following Christmas trade. Since most playthings that are on sale this month were bought last March, their prices do not reflect the rising manufacturing costs that have gone into effect since then. Next year, however, they will be higher.

Just how the defense program will affect the toy industry is not yet clear, but authorities express the opinion that it will not seriously reduce production. As they point out, toys fortunately require relatively small quantities of materials vital to defense. For example, 2,400 tons of raw rubber suffice for all the millions of rubber toys made each year. Plastics have already been applied to the industry and may eventually replace metal and wood to a considerable extent. Many toys of this material were shown at the Modern Plastics competition in New York this year. These included dolls, roller skates, toy soldiers, and indestructible infants' blocks that will withstand gnawing and the other usual punishments.

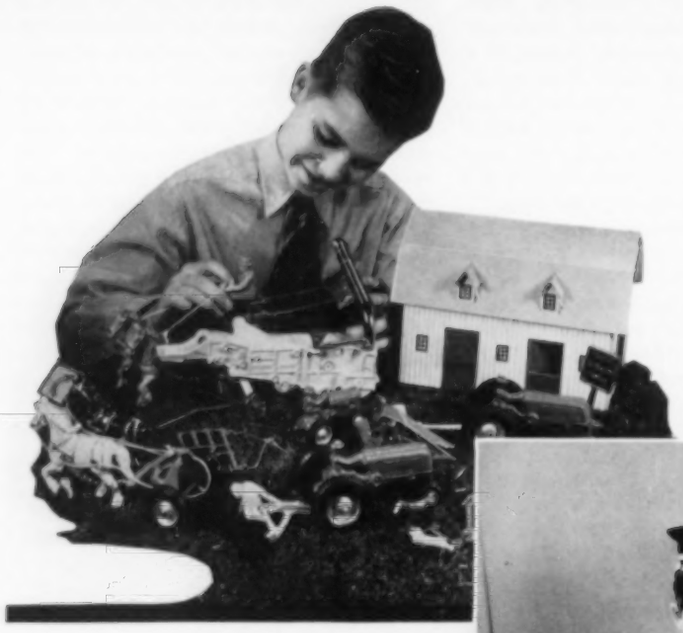
In a normal year, wheeled goods and dolls lead the toy parade, each accounting for about 15 per cent of the sales. Then come metal playthings, other than mechanical, with 14.5 per cent; games, 11.4 per cent; mechanical, other than trains, 9 per cent; trains and equipment, 5.9 per cent; wooden toys, 6 per cent; stuffed toys, 4.9 per cent; rubber toys, other than balloons, 3.3 per cent; balloons, 2.6 per cent; and all other toys, 12.4 per cent.

In the British Museum, one of the leading attractions was a glass case containing the first toys known. These belonged to the children of Egypt, Greece, and Rome, and some were 2,500 years old. There were dolls of ivory, bone, and wood, and even a frayed and yellowed rag doll once cherished by a little maid of ancient Greece. The wooden dolls have swivel joints. There is a rude clay shape of a hare running, a lead chariot only 1½ inches high with a horseman cut out of a thin sheet of metal, a tiny chair and 4-inch sofa of brown glazed ware from a little Roman girl's doll house, rattles which even yet produce a faint noise, mugs and drinking cups, dogs represented by odd little models with pointed noses and long hair, a monkey eating a bun, donkeys with panniers, whistles of baked mud, hoops and spinning tops. The first mechanical toy of which there is knowledge is in this collection. It is the figure of a woman attached by her skirts to a pastry board on which she is kneading dough, her jointed arms moving a rolling pin back and forth.

Some years ago an exhibition of playthings was held in one of the great galleries of Paris for the purpose of showing every object made for the use and amusement of children from earliest times. This brought under one roof the world's finest toy collections, including those of many royal children and historical personages. Here was seen the favorite toy of the little dauphin of France who would have ruled as Louis the Seventeenth. He is believed to have perished in a prison dungeon at the hands of his cruel jailers when he was but ten years of age, although the tale still persists that he was brought to Canada, reared by an Indian family, and was known as Eleazar Williams, a missionary to Midwest tribes. The toy, a tiny bureau with panels of blue porcelain, was given him by his sister. When a spring was

CHRISTMAS CONTENTMENT

A study of childhood by S.B. Pearse. Dolls and animal likenesses have been favorites since time immemorial. The former make up fifteen per cent of the United States Christmas toy trade in a normal year.



THE MACHINE AGE

Military toys have long been popular in America, but there will be no material increase in them this year as a result of the wars abroad. However, the influence of the national-defense program is manifested in a wider use of patriotic color schemes and emblems. Miniature models of all types of United States battlecraft, aircraft, coast-defense forts, and antiaircraft guns are available on the toy counters, along with a variety of farm-machine models and replicas of many kinds of excavating and construction machinery. A new miniature hook and ladder has a piston to compress air for raising the ladder.

touched a little bird appeared and sang.

Among the playthings of Napoleon's handsome son, whose life of early promise was sad and short, was a device of three tricolored balls which were to be thrown by careful aiming into an opening beneath the outstretched wings of an eagle. This toy was designed by Bonaparte himself. A doll named Pandora made many trips across the Atlantic to show American women of Colonial days the latest in Paris styles. The ships on which Pandora rode were guaranteed safety even in time of war, because enemies were more chivalrous than now; and women of means made long journeys by stagecoach to fashion centers to inspect her beguiling outfits.

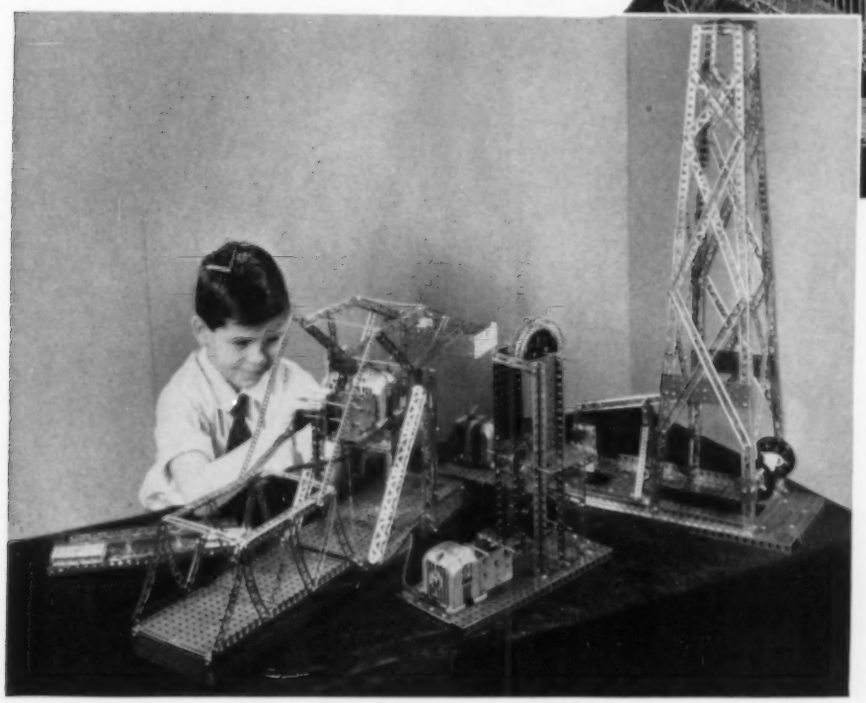
Marionettes, the tiny actors that play romantic parts on the stages of cardboard theaters, have long been popular. An English playwright produced 25 successful comedies for marionette casts, and great operas have sometimes been scaled and mounted on a miniature stage before being sung by living artists. The little wire-pulled players are made with infinite patience and care, and until recently their costumes and equipment were produced by home industry in Italy, Spain, the Tyrol, and Czechoslovakia.

A 35-room toy palace is owned by Mrs. Elizabeth Watson Larke of San Francisco. Some of its treasures must be viewed through a magnifying glass. Whole floors are tiled with 1/12- inch beads; there is an Oriental room with a decorative border made of the tops of old Cloisonné hatpins; and one of the miniature rugs was finished after two months of the most painstaking work. Among its furnishings is a curio cabinet containing a large collection of ½-inch musical instruments of gold. Some of the doll occupants are from less than ¼ inch to ½ inch in height. The structure is built in seven sections around a court-yard with a fountain, garden, porches, and a wrought-copper fence and gate. The fees paid by visitors are used wholly in child-welfare work, the cause for which the palace was designed. Queen Mother Mary of England owns a doll house with the most complete and exquisite furnishings; and Colleen Moore, ex-movie star, has a charming one that is a traveling exhibit for charity.

The world's most-famed dolls were presented to Princess Elizabeth and Princess Margaret Rose by the children of France before the shadow of war fell over both countries. One doll is blonde, the other brunette. Their wardrobes, complete for every occasion, were styled by the great dressmakers of Paris, and even their jewelry, designed by a master of the craft, is genuine. The dolls have been displayed in the large cities of Canada to obtain funds for the relief of war sufferers.

Laurence Gieringer of Reading, Pa., has spent 35 years in assembling a miniature village which is valued at $16,000. It comprises 105 buildings, 38 wagons and automobiles, three trains, 410 lights, 570 trees, and 1,220 figures. There is a church with windows that resemble stained glass, and at intervals, when the lights are dimmed, comes the sound of religious music from within. The trains cross trestles, disappear in tunnels, and emerge in rural districts dotted with tiny farms. The community is built entirely by hand and to scale, weighs 20 tons, and covers an area of 2,000 square feet.

Toy mangers, representing the Nativity, are seen in churches and homes at Christmas throughout the Christian world. What is said to have been the finest crèche was constructed in 1760 for Charles the Third, King of Naples. When it was exhibited the crowds were so great that the soldiery had to be called out to keep them moving and orderly. The manger was 40 feet wide, 25 feet deep, and 15 feet high, and contained 700 figures—500 of people and 200 of animals, all marvelously executed in wood and wax. Vaccia, the world-



BUILDING SETS

Toys such as these have become very popular in recent years. The boy is shown with a Gilbert mechanical set by means of which can be fabricated working models of various industrial machines. The girl is putting the finishing touches on an arch bridge constructed of sticks of wood.

famous instrument maker, fashioned the tiny lutes and harps—in fact, every one who had a hand in the work was the most celebrated in his line in the kingdom. The Queen costumed many of the people with her own fingers, as she was an expert needlewoman.

A man of Strasbourg, France, owns the largest force of lead soldiers in the world. It numbers 800,000 officers and men dressed in the colorful uniforms of all periods of French military history. A resident of Paris has an army of 100,000. Both of these are private collections. Until the outbreak of the present war one of the well-known museums in France had on public display 40,000 lead soldiers representing French cuirassiers and British infantrymen lined up in battle formation to simulate the Field of Waterloo on the afternoon of June 10, 1815.

Mechanical toys are still unknown in many countries. Eskimo children, for example, have the simplest, handmade playthings of which the most popular among boys and girls alike is a doll made of ivory or of seal, dog, or mouse skin stuffed with straw. Those of ivory are from 1 to 3 inches high and sometimes have no faces. Little girls often make tiny seal-oil lamps while watching their mothers make larger ones. Boys are skilled carvers of ivory figures of birds and animals native to the Arctic. Their whistles are made of wood with whalebone inside, and their balls are sealskin stuffed with reindeer hair.

But the toy supreme is the electric train. Locomotives are modeled after streamliners, and rails, structures, and signal and switching systems differ from the regular equipment only in size. One of the world's largest model railroads on exhibition runs in Chicago's Museum of Science and Industry and is a gift of the Santa Fe Railway. It has 1,000 feet of track, equivalent to more than 9 miles of actual railroad, and includes two passenger trains, two freight trains, miscellaneous diesel freighters and switchers, an icing station, shops, and working models of a lumber mill, cement mill, coal mine, iron mine, cotton gin, citrus-fruit packing plant, grain elevator, foundry, machine shop, and an oil field with a refinery.

Two enterprising young New Yorkers have recently opened what probably is the first toy railroad for public use. Men, women, and children pay 50 cents a night for the privilege of operating the half mile of steel track with its 22 trains of five or six cars each. There are four levels, four big bridges—one of which is 15 feet long—and many smaller ones, together with switches. The movements of the trains are regulated by means of 24 operating boards; and the system is designed with easily controlled sections for beginners as well as with complicated ones for experts.

Eleven childrens' railways have been built in Russia in the past five years and are exact reproductions of real steam and electric lines. They are managed entirely by youngsters between the ages of twelve and sixteen who thus, through play, become proficient railroaders. Not long ago the Soviet Government made a grant of 3,000,000 rubles for such railways, which is in addition to sums set aside for this purpose by other organizations.

Science is curious to know why children of early Briton, boys and girls of the Middle Ages, the copper-hued Indians of North America, the South African blacks, the brown Malaynese, and others of all races and climes have, until of late, played virtually the same games and had practically the same toys. Perhaps it is because childhood, without language, racial, and color barriers, always has been, is, and always will be the same the whole world over.

Dredging the Kennebec River

W. H. O'Connell

THE DRILL BOAT

Pictures of the craft at work near Bath, Me. At the left is a view of the columns each of which carries an X-71 drifter. Drilling is done through an average water depth of 21 feet. The deck of the vessel, with Jackrods of varying lengths in the foreground, is shown above. The men are: Capt. J. Jacobsen of the drill boat (left) and Joe Maurer, superintendent of the drilling and dredging operations.

BATH, in the State of Maine, is today the scene of the same bustle and rush that characterized her golden age between 1907 and 1922. In those years the population increased some 50 per cent, and the town's shipyards launched 455 seagoing craft, both commercial and naval. The community is located on the west bank of the Kennebec and about 12 miles from the open sea. The channel of the river in this section averages much deeper than the 27 feet required by the largest of the vessels built in Bath shipyards; but the route to the sea is by no means easy to navigate. Tiny and picturesque islands, covered with trees and shrubs, dot the surface and give the impression (substantiated by fact) that they are the overgrown tops of rock pinnacles thrusting up through deep water. These can be avoided, while others, that are totally submerged and often reach close to the surface, imperil the passage of deep-draft boats. Although it is possible to pilot vessels drawing 27 feet of water through this stretch of the river, the safe channel is narrow, and its twisting course makes it necessary at times to swing a craft athwart strong tidal currents.

These factors lay behind the War Department's decision to create a safer and more navigable channel from the shipyards at Bath to the sea. In July, 1941, a contract was awarded to Sunderlin & Watrous, Inc., of Providence, R. I., for lowering the underwater pinnacles by the removal of 34,000 cubic yards of rock and for dredging 35,000 cubic yards of sand from the river bottom. Work on the project was begun on July 31 and involves operations in six different ledge areas. The average starting point for excavating is 21 feet below mean low water, while the maximum depth of cut is approximately 20 feet and the average 6 feet. A 5-yard clamshell dredge is employed to clear away the sand deposit from the river bed, and the spoil is taken to deep-water sections of the stream by barges. While this is in progress, two crews are busy drilling and blasting in the rock zones, and when their work is completed the clamshell dredge will remove the shattered material.

A drill boat with three frames or columns has been at work since the start of

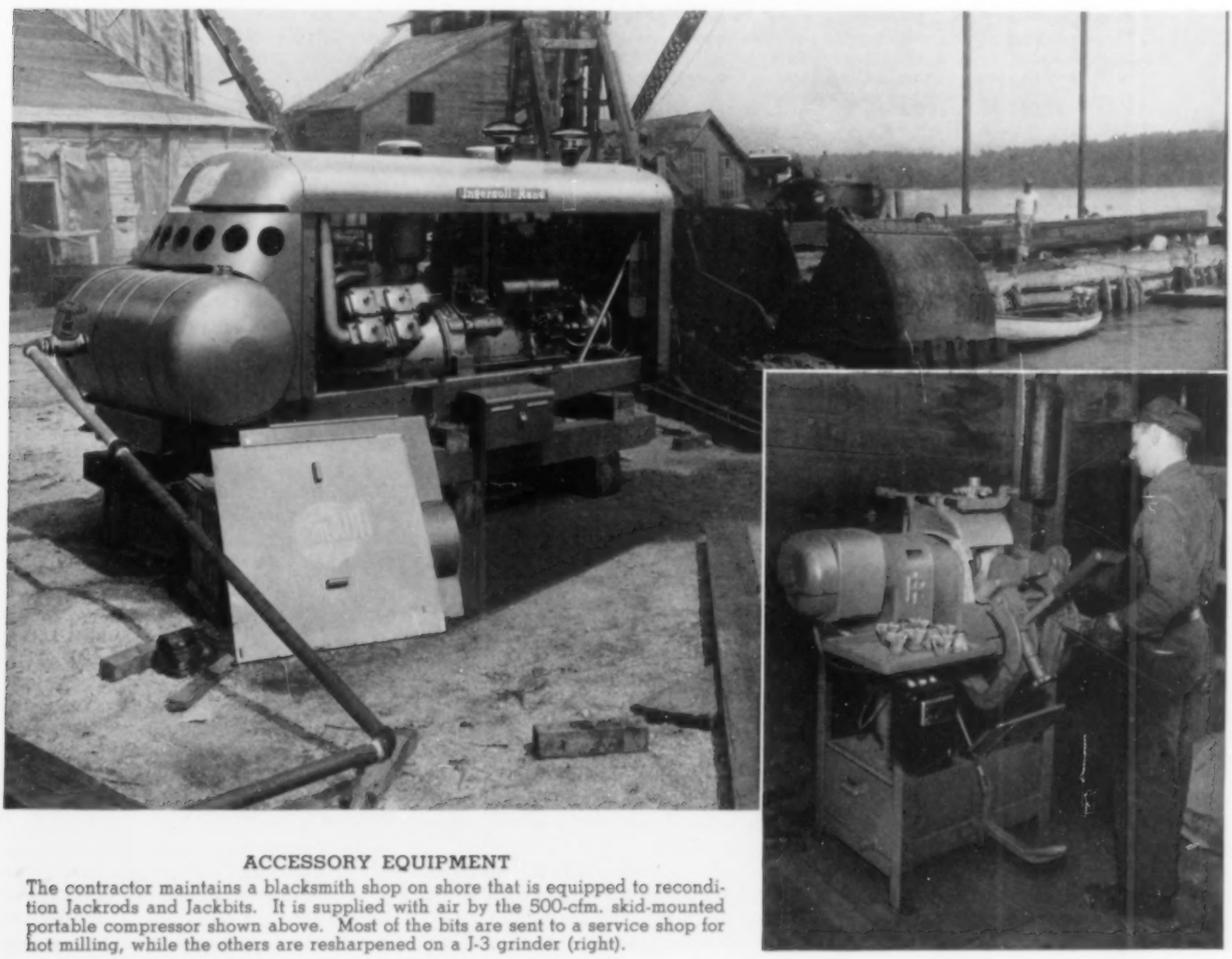
the undertaking. Each column carries an X-71, air-operated, blower-type rock drill that slides on rails. The machines are raised and lowered by chain falls, and air for drilling is furnished by an Ingersoll-Rand steam-driven, duplex compressor. In addition, there is a spud-supported platform or drill stand on which are two similar drills. These are raised and lowered by two EAU air-operated hoists and are supplied with air from a lighter on which an HK-500 skid-mounted portable compressor is temporarily installed. Holes are started and bottomed with 3¼- and 2½-inch bits, respectively; and 1½-inch drill rods, with a ½-inch hole for blowing, are used. Blasting is done with large-diameter sticks of dynamite.

Following a trial period with forged drill steel, it was decided to utilize Jackrods and Jackbits—detachable bits. By cutting out the transportation of all but a few 20- and 30-foot steels, and by greatly reducing the investment in rods, this step has resulted in marked savings. Most of the dull bits are sent to the hot-mill bit-reconditioning shop of H. Orlando & Sons in Portland, Me., while the remainder are returned to the contractor's blacksmith shop where they are resharpened on a J-3 grinder. This shop is completely equipped for reconditioning both bits and rods, and includes a Size 54 sharpener, a 27F furnace, and a Size 500 cut-off grinder. Air is supplied by an HK-500 skid-mounted portable compressor.

By reason of the fact that the tide rises as much as 12 feet in the estuary of the Kennebec, the level of the water in relation to the working site is continually shifting. Moreover, the current also reverses its direction, for the backwater from the incoming tide extends upstream far beyond the Town of Bath. These changing conditions, plus the swiftness of the tidal currents and the great variation in the depth of the water, call for no little skill in maneuvering the drill platforms. This is accomplished by pulling in or letting out the four anchor cables extending from the corners of the craft; and as the cables are held several hundred feet apart, the drill boat can move about within a considerable area before it has to be towed to a new location. Once the drill boat or the drill stand is over the rock to be removed, pipe spuds at its four corners are lowered to the bottom. The thrust exerted on these legs serves to lift the craft somewhat and to hold it for drilling.

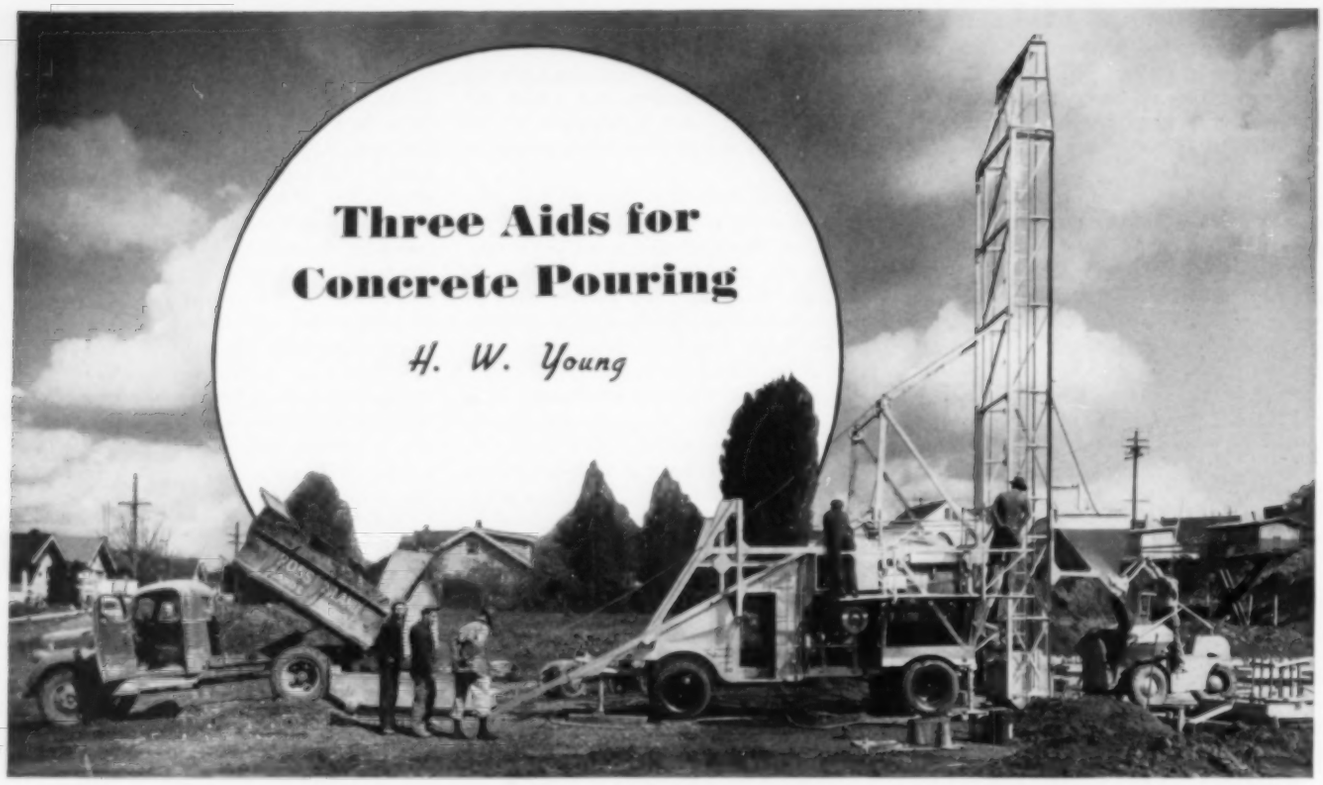
With a platform in position, a length of 4-inch pipe is lowered through the water to the rock to collar each hole and to serve as a guide in changing steels and bits and in loading the hole with dynamite. The boat is then shifted, and another series of holes is drilled and loaded. When two sets of holes have been prepared for blasting, the craft is moved about 100 feet away, trailing the detonator wires connected to the dynamite caps. The charge is now set off, usually with little visual evidence at the surface of the water, although the vessel is lifted appreciably. Occasionally the white belly of a stunned fish breaks the surface after a blast, but this is unusual because the vibrations set up by drilling keep most fish away from the area of disturbance.

The work of improving the Kennebec channel is scheduled to continue throughout the winter months and to be completed in July, 1942. Joe Maurer is general superintendent for all drilling and dredging operations for Sunderlin & Watrous, Inc. The project is under the direction of Lieut. Col. Leonard B. Gallagher, District Engineer, U. S. Engineer Office, Boston, Mass.



ACCESSORY EQUIPMENT

The contractor maintains a blacksmith shop on shore that is equipped to recondition Jackrods and Jackbits. It is supplied with air by the 500-cfm. skid-mounted portable compressor shown above. Most of the bits are sent to a service shop for hot milling, while the others are resharpened on a J-3 grinder (right).



Three Aids for Concrete Pouring

H. W. Young

MIXERMOBILE AT WORK

The apparatus is being used here to pour concrete for the basement of a building. The tower is at its normal height of 35 feet, but can be extended to 65 feet as the structure rises. The hopper attached to the tower is at its lowest position and is feeding concrete into a Buggymobile for delivery to the forms. At the left a truck is dumping a measured batch of aggregates into a skip, which is pulled up to the mixer for discharging its contents.

UP TO two or three years ago, the contractor setting out to build a concrete structure always reared a timber tower that considerably overtopped the highest level of the concrete. A hoist and cage and a chute of sufficient length to reach all pouring points were then added. After the work was done came the job of dismounting the equipment and the tearing down of the tower. The hoisting machinery and chute cost around $1,000. While they could be used over and over again, it took a good deal of time to install, take down, and move them to another job or put them in storage. The tower itself represented a loss of about $100 in lumber, plus the time of erection and dismantling. Over and above these cost factors was the fact that at least a day of pouring time was usually lost in setting up and getting ready.

As a result of these unsatisfactory conditions, there is now occasionally seen in scattered parts of the country a unique type of portable equipment that goes under the name of Mixermobile. The number of units in service is growing as fast as the capacity of the small plant in Portland, Oreg., where it is being constructed, will permit. Mixermobile Manufacturers is typical of many new concerns that were just getting underway when the national emergency arose. How long it will be able to obtain steel with which to continue, or when Uncle Sam may come along and say it is time to start making tanks or other war matériel, are questions that do not lessen interest in this enterprise and in the three types of near-revolutionary equipment that it is turning out. The Mixermobile promptly called for something to expedite the transfer of the concrete from the point of delivery—for the Buggymobile; and the answer to the problem of transporting the former in rough and mountainous regions is a sort of Siamese-twin type of truck one look at which causes one to wonder if it is not time to visit the oculist.

Ed. H. Wagner & Sons started contracting in Portland in 1924. Four years later the business was taken over by the two sons, G. H. and Harold. By 1932 they felt the need of more suitable equipment than was then on the market for the construction of concrete buildings—something that would do away with the repeated expense of tower erection and hoist installation. Harold Wagner, who had been keeping the company's limited mobile equipment in running order, went at the task of designing and constructing for its own use what eventually turned out to be the Mixermobile.

Resorting to junk yards for material, he cut it up with a torch, and with an arc welding machine, that he made himself, spot welded the parts so that they would hold together until he could get them to a custom welding shop. In this way the first Mixermobile was completed and used by the Wagners on contract jobs. Some observers said it was a silly idea and would never work; but it did work, and so well that two more were built the next winter and another the following summer, all for their own use. It was then they decided to go into the business of manufacturing them.

News of the new machine did not travel fast. Three or four years elapsed before the first three were sold. That was around 1939. By June, 1940, when Mixermobile Manufacturers was established, orders began to come in in a modest way, and since then about 100 have been purchased in the United States and Canada. Those in the latter country and in the eastern states were built there according to specifications furnished by the company. With a new factory building and modern equipment, the current production is about three a month. This is a sizable business, not taking into account the two other products, because a big Mixermobile runs into considerable money—approximately $10,000 each.

When ready to go from one job to another, the Mixermobile has much the appearance of an old-time grain separator and is about the same size. It is a rebuilt Ford V-8 truck chassis mounting a con-

crete mixer with power plant and a folding steel tower, which rests in a horizontal position on top of the rig when in transit. Arriving at the job, the tower is raised. The normal height is 35 feet; but this can be increased by 10-foot extensions to 65 feet, which is the practicable limit without resorting to elaborate guying. The latter height will suffice for 4- to 6-story buildings.

Traveling in the tower is a bucket, with a capacity of ¾ cubic yard, dumping into a 1½-cubic-yard movable hopper that can be locked at any desired height on the outside of the structure. The mixer has a capacity of 2 cubic yards, and while one batch is being elevated and placed another one is being mixed. At the forward end of the vehicle a power-driven loading skip receives the aggregates for each charge from a truck and carries the material up to the mixer as it is needed. The entire plant, from the delivery of the aggregates to the placing of the concrete, has a maximum capacity of 40 cubic yards an hour; and when set up it can be operated by one man.

When the Mixermobile was first put to use, it was found that one of the operations in the cycle created a bottleneck. The problem was that of getting the concrete away from the tower hopper fast enough to keep pace with the mixer. Manifestly, most of the advantages of the system would be lost if a swinging chute would have to be used, because it would necessitate a tower reaching to a height considerably above the pouring level to permit the concrete to flow by gravity. This method being impracticable, the only alternative seemed to be the time-honored wheelbarrow.

But barrows and man power were a combination nowhere near fast enough to handle the concrete, so Harold Wagner designed what amounts to a large wheelbarrow with an engine on it to which the name Buggymobile was given. The first one was introduced in October, 1940, and since then more than 50 of them have been built and sold in addition to those needed for their own work. They come in two sizes: one with a ½-cubic-yard hopper and a 4-cylinder tractor motor and the other with a 1-cubic-yard hopper and a 6-cylinder motor.

The Buggymobile has three wheels, the forward pair carrying most of the load and the rear one serving for steering. The operator sits facing forward, and the gooseneck steering lever from the rear-wheel assembly goes over his head and hangs down in front of him. The smaller outfit will go just about anywhere where a man can go with a loaded wheelbarrow. Because of this, the Mixermobile is doing all kinds of light work such as pouring basement walls, floors, and outside walks and stairways of moderate-sized homes. The unit can travel as fast as any truck, taking the Buggymobile along. As soon as the first truck with cement and aggregates arrives, the plant is ready for service. The Mixermobile operator, buggy operator, and possibly one wheelbarrow man to get into the less accessible corners, replace the mixer crew of three and three wheelbarrow men usually required for these small jobs, besides doing them in much less time.

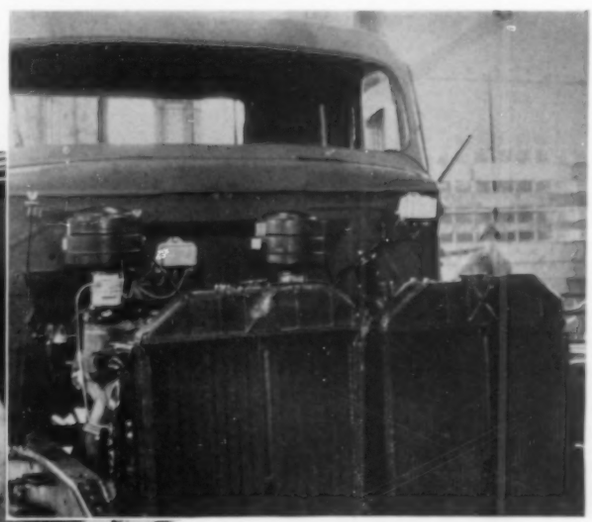
The third member of this family of mechanical innovations is a twin-motor truck. As before, the Wagners made the first one to expedite their contracting work and to give it a thorough trial. The main reason the building contractor needs such a truck in the mountainous country of the Pacific Northwest, especially, is to have available a large reserve of power for heavy grades in transporting equipment and materials—power that can be kept in reserve without interfering with the normal operation of the truck when the hill has been climbed.

This unit is a modified Ford truck with any desired body or tank and with two 6-cylinder engines, side by side, covered with a twin hood. There are four wheels at the rear, and each engine is connected through its own transmission to a pair of them, each driving arrangement being entirely independent of the other. In level country, and under ordinary load and road conditions, the operator uses one motor and one pair of wheels. On a heavy grade, instead of creeping upward at a snail's pace, he simply kicks in the other engine and zooms up at practically normal speed. He has, in effect, a 12-cylinder, 4-wheel-drive vehicle. There are other advantages to this, aside from extra power. If one motor gives trouble on the road, the truck can get in with the other, thus saving time and perhaps towing charges. Ordinarily, the truck is driven first with one and then the other pair of wheels so as to equalize tire wear. In an emergency, when carrying a load, it is possible to make better time on the level by using both engines.

What other revolutionary ideas are to come out of the Wagner minds remains to be seen, but it is understood that several new ones are about to materialize. In the meantime the little factory is employing some 30 men.

IT GOES WITHOUT BEING PUSHED

The Buggymobile is a sort of *de luxe* wheelbarrow that delivers up to a cubic yard of concrete at a time to pouring points. It is being used in this case to pour a floor for a porch. The operator rides it and steers it by means of the gooseneck lever.



A SIAMESE TRUCK

Two engines are mounted side by side, under a common hood. Each is connected to a separate pair of driving wheels. The truck is ordinarily operated with one engine, but the second one is called upon whenever more power is wanted.

Compressed Air in Hollywood

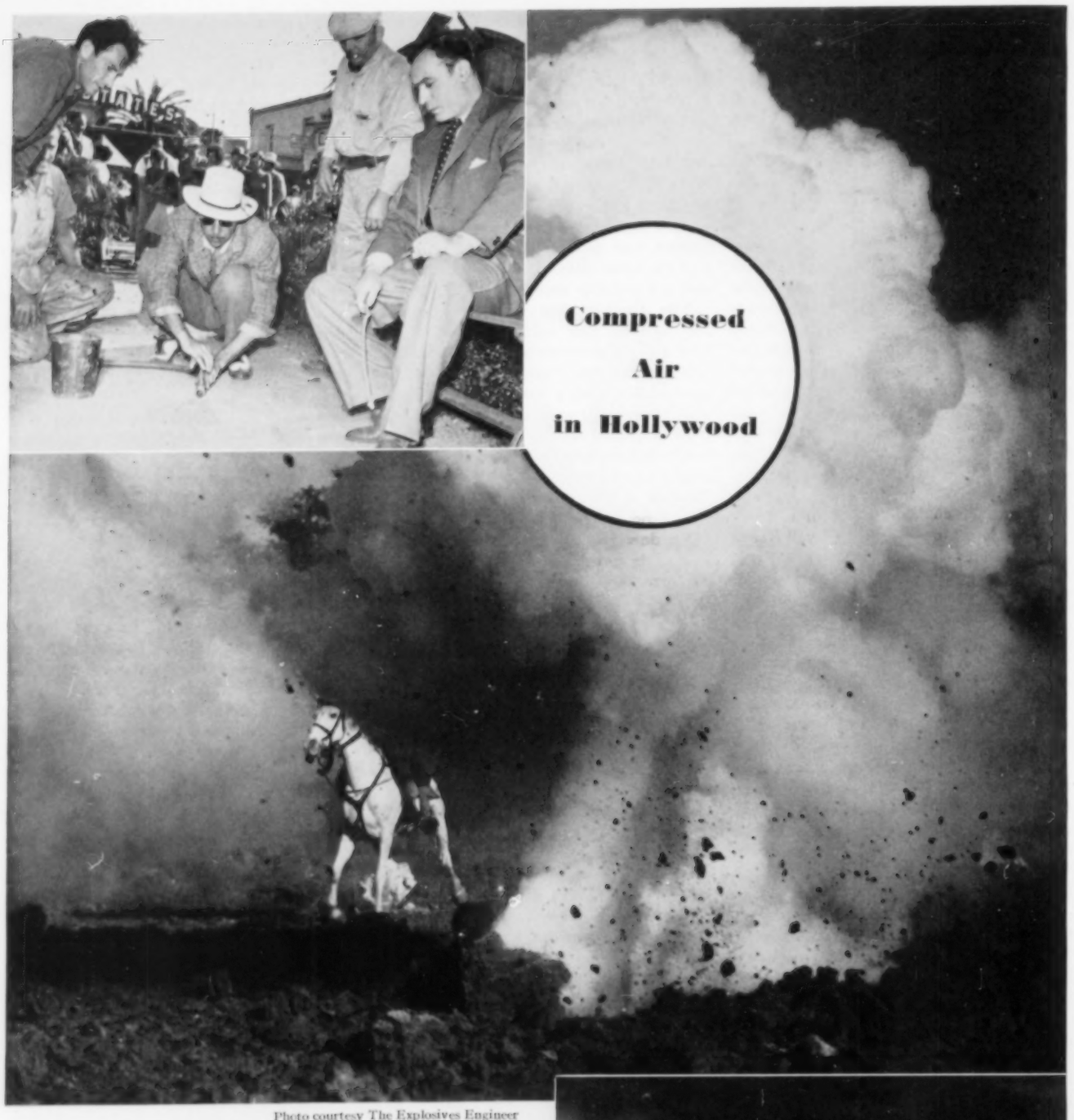


Photo courtesy The Explosives Engineer

EVERY now and then one hears of a new use to which compressed air is put on the movie lot. The latest contrivance that is finding general application there is a so-called air-mortar that serves to add realism to battle and similar scenes without endangering the players. It consists of an 8½-inch pipe branching out into a series of pipes about 1½ inches in diameter and is fed air at 150 pounds pressure from a cylinder. Earth, debris, small quantities of powder, and smoke-creating substances are piled over the mouths of the latter pipes. The powder and the air blast are timed to go off simultaneously, with the result that the materials are thrown forcibly upward and the atmosphere is filled with flying particles and thick with smoke just as it would be if an actual explosion had taken place. The effect is graphically portrayed in the center scene from the Paramount screen production "Caught in the Draft." Clouds of dust are raised in the same way, except with the use of compressed air only. At the bottom is Columbia's special-effects man, Fred Wolf, "fogging up" a set for the movie "Ladies In Retirement" with the aid of mineral oil blown in highly atomized form from an air-operated gun developed for the purpose. The picture at the top was taken on the Paramount lot just before the popular screen star Charles Boyer (with stick in hand) wrote a message in the sand in the current production "Hold Back the Dawn." To make the words legible when photographed, Director Mitchell Leisen is leveling the sand with low-pressure air.

Factory Suggestion Plans

EVERY manufacturing company welcomes ideas from its workmen; but comparatively few let that fact be known to their employees, and still fewer make consistent efforts to obtain ideas from them. In small establishments the executives often know most of the shopmen personally and are familiar with all the details of the operations. They make regular trips of inspection through the plants, observe the men at work, talk to them occasionally, and listen to their suggestions and complaints. These contacts rarely exist in large concerns, for obvious reasons. Foremen are, of course, in close touch with the workers; but shopmen usually hesitate to lay anything before them unless they are definitely encouraged to do so.

One way of getting ideas from workers is through a suggestion plan with a provision for rewarding proposers of usable ideas. A good many firms have found that such a system more than pays its way by reducing manufacturing costs: others are doubtful about this point, but they consider the resultant betterment in management-employee relations to be worth a great deal.

In the third quarter of this year, General Electric Company paid $23,698 to shop workers in all its plants for 2,574 suggestions that were accepted from among the 11,000 that were made. The G-E suggestion plan started twenty years ago when one Christian Steenstrup devised an automatic feeder for punch presses that was an improvement on existing hand-feeding methods. His foreman refused to try out the equipment, so Steenstrup put it on a press during his lunch hour and was discharged as a result. Thereupon he presented himself at the front office, which gave him back his job and accepted his idea. Out of this incident grew the suggestion plan under which ideas are weighed by committees and accepted ones paid for in cash, the awards varying according to the savings effected. Incidentally, the encouragement given Steenstrup led him to keep on inventing things. He now has more than 100 patents to his credit and is one of the company's chief engineers.

●

War-Winning Slogans

THE editor of the *Modern Engineer*, published in Melbourne, Australia, voices the opinion that the "V for Victory" slogan will not accomplish its purpose until it gets into the hearts of the people instead of merely on their lips. The letter V, he points out, stands for five as well as for victory and is the initial letter of five other words that must be incorporated in the Allied movement if victory is to be won. The words are:

Volunteers. The Australian policy is against conscription and favors voluntary army service.

Vigilance. The point is made that if it had been properly exercised following the last war we would not have the present one.

Veracity. Because no government has the courage to trust the people with the truth there is a tendency to doubt or regard with suspicion information that is given out through administration channels.

Vigor. Only by whole-hearted backing of the armed forces can battles be won. Reference here is to bickering by politicians, strikes by labor in key industries, and exploitation of the public by profiteers.

Vision. Foresight in making postwar adjustments is necessary if a world-wide depression is to be averted following the cessation of fighting.

"Victory," concludes the writer, "will go to the side that has consecrated everything to the one great purpose, and not to the side which whole-heartedly adopts a slogan and half-heartedly works for its realization."

Bessemer's Start

IN a review of the literature dealing with powder metallurgy, a development of growing importance to industry, Prof. Clark B. Carpenter of the Colorado School of Mines points out that Sir Henry Bessemer, inventor of the Bessemer converter, founded his fortune by devising a means of producing powdered metals. But for the money it brought him he probably would have been unable to establish the worth of his converter, for it was at first deemed unsuccessful and he had to set up his own steel works to prove that his air-blown vessel would produce steel.

Bessemer's work with metal powder began when he was a mere youth and resulted from a request by one of his sisters that he letter the outside of a portfolio of flower paintings. He wanted to gild the letters, but found that the so-called gold powder cost some $26 a pound, although it was made from about eighteen cents worth of brass. Thereupon, he developed a method of making bronze powder; and, to keep it secret, he and his three brothers-in-law conducted their operations for 40 years in a windowless building equipped with skylights.

It is believed that they machined cast billets and passed the fine filaments thus obtained through rolls that broke them up into powder. This was polished by adding minute quantities of olive oil and by dropping the material from a height so that the particles rubbed against one another. The product was classified into sizes by blowing it through a tunnel, approximately 40 feet long and 2½ feet wide, with air, the finest material being caught in silk bags at the far end. Bessemer succeeded in powdering many different metals and sold them at an enormous profit. At one time he supplied brass powders to a large part of Europe. He retired from the business in 1885, and it was not until 30 years later that modern methods of producing powdered metals were worked out.

Prizes Offered Writers on Compressed Air

A PRIZE contest for papers dealing with any phase or aspect of the use of compressed air is being sponsored by Compressed Air Institute, a trade association comprising 23 leading American manufacturers of compressed-air equipment. It will run until June 1, 1942, and the prize money, totaling $500, will be divided into one $100 award, three $50 awards, and ten $25 awards. Winning papers that are considered suitable for publication will be offered to trade journals, and authors will receive any revenue derived from those sources. In addition, the Institute will pay $25 for each non-prize-winning paper that is accepted for publication by a technical journal.

Employees of any concern using compressed air or associated with its application may enter the contest. Detailed information may be obtained from Russell Gross, educational director of the Institute, at 45 Warrington Place, East Orange, N.J. Posters announcing the contest and its rules for display on bulletin boards also are available.

Creep of Metals Determined by New Method

SOLID metals used in turbines and other vital defense machinery actually flow when heated and stressed. The rate at which this flow or creep takes place can be determined in days instead of months by a new method, according to Dr. Saul Dushman, assistant director of the General Electric Research Laboratory. Speaking before the meeting of the American Society of Rheology, which is devoted to the study of the deformation and flow of matter, Doctor Dushman said that metals like lead creep at room temperature when under stress while harder metals are caused to flow when subjected to higher temperatures and stresses. In general, the higher the melting point of a metal, the greater its resistance to creep.

It is a well-known fact that the efficiency of steam turbines increases as the temperature rises. But with an increase of 100°F. the creep rate at any given stress goes up 5 to 100 times, depending upon the material. Metallurgists therefore have attempted to make alloys that will withstand the highest possible operating temperatures. To determine the rate of flow of a metal, it has been the practice to place bars of it in furnaces at approximately normal operating temperatures—from 800 to 1,400°—and to subject them to stresses such as they would receive in service. By this method the test periods last anywhere from a month to a year.

By Doctor Dushman's accelerated creep test, a thin wire of the metal is heated to glowing temperatures of 1,500 to 2,000° by an electric current. The wire is inclosed in a glass cylinder through which nitrogen is circulated to prevent it from rusting as it would if exposed to the atmosphere. A weight suspended from it exerts the desired pull. By watching the lower end of the wire through a microscope, the stretching due to creep is measured. This lengthening amounts to as much as a half of one per cent in an hour, so in a day or two data are obtained that would require months to accumulate by the old procedure.

Alloys of iron with chromium, nickel, and molybdenum are found to be more highly creep resistant than others that have been investigated. Although this work has important practical applications, Doctor Dushman is particularly interested in studying the atomic mechanism of the creep and in correlating it with other properties, such as tensile strength. The results so far obtained experimentally suggest the theory that creep is caused by the movement of groups of atoms numbering from 50 to 1,000

Lighter Machine-Tool Gray

AT THE last annual convention of the National Machine Tool Builders' Association was adopted a lighter shade of gray as the standard finish for machine tools. It is known as 7-B, and was accepted by vote in response to a desire on the part of large-scale users of machine tools for a color with a good light-reflection value. Though it shows up dirt and fingerprints more easily than the familiar dark gray, it has been found in one large plant where all the tools have been repainted with the new shade that it improves the light at working heights—33⅓ per cent in the case in question—and that the operators do better work and take more pride in their machines. The color is available in quick-drying spraying lacquers and in brushing enamels.

Ear Defenders

IF YOU can't get rid of a noise at its source, your best bet is to reduce it to a point where workers will not be affected by it. This, we are informed, can be done by Ear Defenders, which have been designed by Dr. Vern O. Knudsen, an authority on acoustics and professor of physics at the University of California in Los Angeles, and Dr. Carey P. McCord, medical director of the Industrial Health Conservancy Laboratories at Detroit, Mich. They fit snugly in the ears, and are constructed with an air space between an outer barrier of metal and an inner flexible barrier, which is an integral part of the Ear Defender proper—a tapered tube molded of nontoxic, surgical-type soft rubber. It is claimed that these impediments tone down disturbing noises by 35-45 decibels, or to about 1/10 their intensity. They are sold in three sizes by Mine Safety Appliances Company.

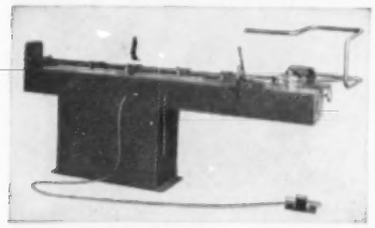
Vought-Sikorsky Aircraft

GOGGLE TRUCK

This unique vehicle makes daily rounds in the plant of the Vought-Sikorsky Division of the United Aircraft Corporation cleaning and repairing the workers' goggles and fitting new ones where needed. The service is proving highly satisfactory, for most men are prone to lay their protective glasses aside if they need attention rather than take time out to keep them in proper condition.

Industrial Notes

Adaptability and high-speed of production are features claimed by Pines Engineering Company, Inc., for its new Series 200 pneumatic tube bender. The machine is equipped to handle soft-annealed copper or aluminum-alloy tubing from ⅜ inch to 1½ inches and 16-gauge soft-annealed steel tubing from ⅜ to 1 inch, outside diameter, and is designed to



turn out simple and intricate shapes such as chairs. The work is done with the aid of a mandrel, and the bending die is actuated by a push-button or foot-controlled 4-way valve that is direct connected to a special air cylinder, thus obviating the use of long air lines. The operating pressure varies with the size of the tube and the radius of the bend. The angle of the bend is adjusted by a selector wheel which positions any one of six positive stops between a lug on the frame of the machine and a collar on the end of the piston rod. This permits duplicating a bend as often as desired, while a selecting arm enables the operator to give a tube a series of bends at predetermined points. Standard equipment includes a complete set of bending dies built to customers' specifications; and the manufacturer furnishes a mechanically or air-operated pulling device for withdrawing the mandrel in case it sticks in a tube. The equipment is said to make bends that require no subsequent adjustment at an average rate, in the case of 1-inch 16-gauge tubing, of 250 an hour.

Wind power was recently supplied to 1,600 homes when the vento-electric station on Grandpa's Knob near Rutland, Vt., was hooked up with a commercial power system for test purposes. With a 26-mile-an-hour wind spinning the great windmill, 2,000 feet up on the mountain top, the turbine produced 800 kw. When tuned up and ready for service, it is expected to develop 1,000 kw. The plant was briefly described in our April, 1941, issue.

As a result of three years of research, Canada is in a position for the first time to produce metallic magnesium, which is now so vital to national defense. A process has been perfected by the Industrial Minerals Division of the Department of Mines and Resources by which magnesium oxide can be obtained from brucitic limestone, of which extensive deposits are available near Wakefield, Que. A refining plant is being constructed there under an agreement between the Aluminum Company of Canada, Ltd., and Canadian Refractories, Ltd., and is expected to be ready for operation early in 1942. The output will initially be used for making firebrick and similar refractories.

Ore previously classed as waste will provide Canada with 10 per cent of her tin requirements. This announcement comes from the Consolidated Mining & Smelting Company, which has started the production of this mineral on a semi-commercial scale at its Kimberley, B.C., plant by a newly developed process.

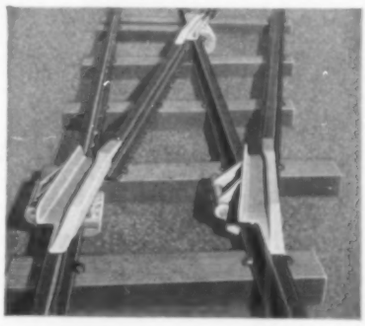
It is claimed that electric bulbs, goggles, and plain glass exposed to spatter from welding operations can be protected against pitting by No. 253 Glascote Clear, a product of John C. Dolph Company. The liquid forms a transparent film, dries in about half an hour after application, and can be easily removed. One coat is good for 25 hours of service.

From Switzerland comes the news that a Geneva watchmaker, P.R. Jaccard, has succeeded in perfecting a watch spring that does not lose its power as the timepiece runs down—that always has the same driving power on the movement. It is suitable for tower clocks and tiny wristwatches and is said to guarantee the regular movement of a timepiece from the moment it is wound up.

The accompanying illustration shows the new 2-direction speed-control valve designed and built by Hanna Engineering Works for pneumatic cylinders. It is installed between the operating valve and one end of the cylinder and provides adjustable, independent control of the inflow of air to and the exhaust of air from one side of the piston, thus regulating its

speed of travel in both directions. For extra sensitive control the use of two valves, one for each end of the cylinder, is recommended. The unit is constructed so that the two orifices which regulate the flow of air are set before it begins, thus insuring control from the start of the movement. It is suitable for pressures up to 250 pounds per square inch and is available in pipe sizes ranging from ⅛ to 1 inch. The body of the valve is cadmium-plated and all other parts are made of corrosion-resistant materials.

Switch Connector is the designation of a temporary jump-over switch for mine haulageways recently introduced by the Portable Lamp & Equipment Company. By the use of this device the man-hours ordinarily required for installing a switch are, it is said, often reduced more than half because it obviates cutting the main track. The equipment is made up of two turnout castings and one frog casting, all



of which are hinged to base members bolted to the rails. This arrangement permits swinging the parts on or off the rails, as needed. The units come in two combinations corresponding to a conventional switch with No. 2 or with No. 4 frogs.

It is reported that metals are being heat treated without surface decarburization on a commercial scale by the use of Drycolene. This new gas was announced a year ago at the National Metal Exposition as the latest development in protective atmospheres for scale-free hardening, bright annealing, sintering, and electric-furnace brazing of high-carbon steels.

Subzero temperatures down to –50°F. can be maintained in a freezing unit made for industrial purposes and laboratory use by the Motor Products Corporation. It is named Deepfreeze and serves in machine shops for the contraction fitting of metal parts; in airplane plants for the storage of annealed aluminum alloys; in gauge and tool shops for seasoning, setting, and counterannealing precision tools; and is also used for calibrating instruments and for test purposes. The storage chamber is a double-walled cylinder with a capacity of 4½ cubic feet. Forming an integral part of the chamber is a Freon cooling unit—a 2-cylinder, piston-type compressor operated by a ⅓-hp. motor.

Lebanon Offers 30 Years Experience . . . and More Than 30 Alloys for Steel Castings

ON DECEMBER 11, 1911, the Lebanon Steel Foundry was organized by the two men who still head it—W. H. Worrilow, President and T. S. Quinn, Treasurer. Lebanon's thirty-year study of foundry practice (domestic and European) . . . Lebanon's thirty-year development of alloys for wider and wider ranges of casting application . . . today make Lebanon the choice of those who insist on fine craftsmanship and expert design.

The famed Circle Ⓛ now marks castings made in more than thirty different alloys. These Lebanon Steels cover a broad range of applications in many fields.

The right men using the right methods for the right kind of American defense—that is the immediate picture at Lebanon. Meanwhile, Lebanon metallurgists are studying future applications for stainless steel castings . . . and are ready to discuss significant developments with forward looking organizations.

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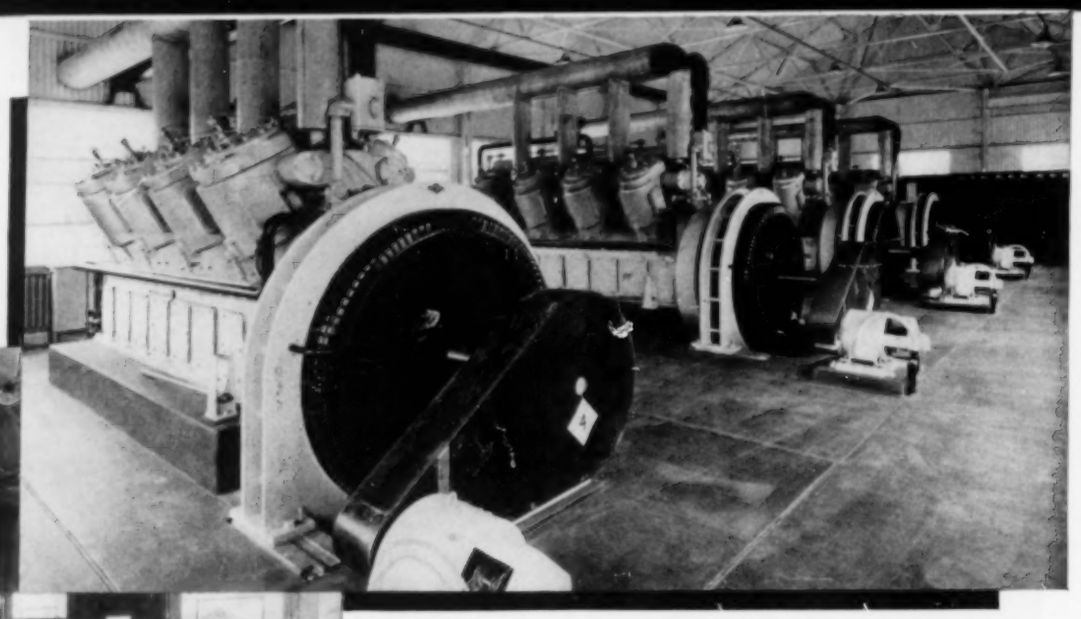
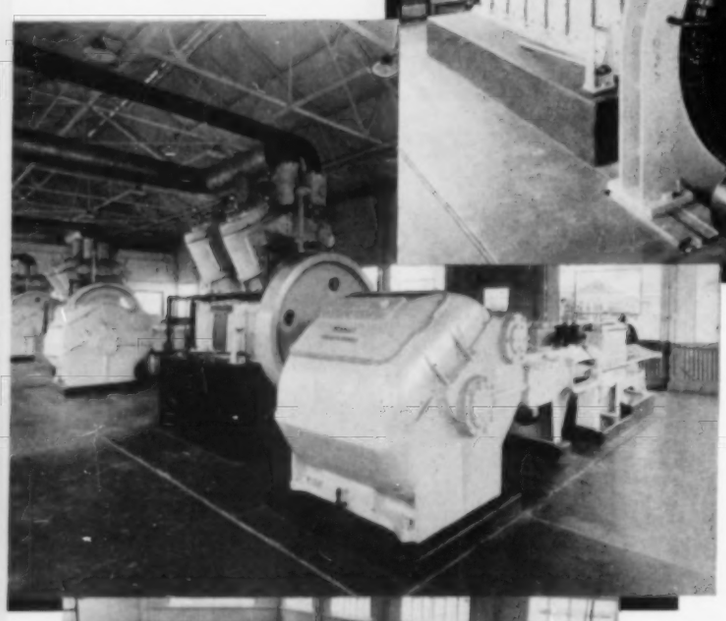




IN the new Cotton Valley Cycling Plant in Webster Parish, Louisiana, a number of Ingersoll-Rand products are performing important functions.

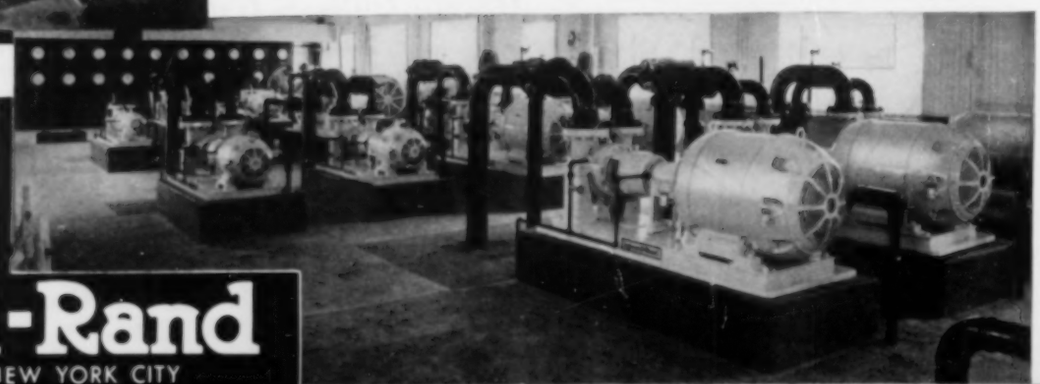
Four 370 H.P. Type PVG four-cycle gas engines are driving the main electric generators. Three 185 H.P. Type PVG's are driving the lean oil reciprocating pumps.

I-R Cameron single and multi-stage pumps are handling jacket, raw and sump water—fat oil—heating oil—still and gasoline reflux—depropanizer feed and reflux.

And, I-R Pneumatic Tools are used for plant maintenance.

Other I-R products for the oil industry include: Gas Engine Driven Gas Compressors and Vacuum Pumps, Diesel Engines, Steam Jets, Stationary and Portable Air Compressors, Blowers and ali types of Air Tools.

Branch offices in every producing center



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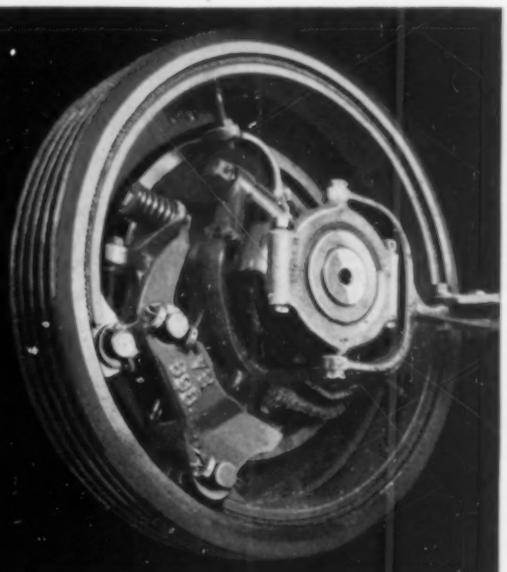

One of four duplicate clutches that give the ¾-yard 20-B its famous direct-action control.

SPEED of operation and accuracy of control on Bucyrus-Erie cranes are, in part, due to the care used in designing the extra large area clutches and brakes so that they take hold uniformly with a smooth firm grip. They keep cool in operation, hold accurate adjustments for long periods. The special linings grip firmly without chattering, and have exceptionally long life.

Provision is made for accurate and convenient adjustment, through a single adjustment unit. Adjustments once made "stay put" on Bucyrus-Erie cranes. The operator always has the feel of the machine and the sure confidence in the clutch and brake action that permits fast, steady operation of the machine at all times.

We believe any shovel, dragline, or crane operator familiar with our modern designs will tell you that Bucyrus-Erie has the smoothest, easiest operating, most dependable clutch and brake system offered by any manufacturer in this field. Find out about the savings fast-moving Bucyrus-Eries offer in your material handling.

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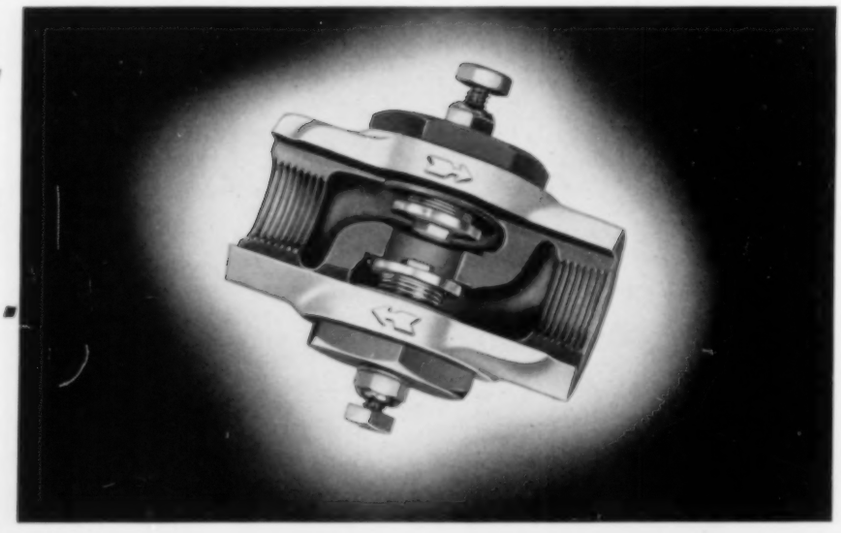

Hanna *Two-Direction* Speed Control Valve

For controlling piston speed in both directions. Installed between the operating valve and one end of a cylinder, it provides adjustable control of inflow as well as exhaust of the air independently to and from one side of the piston.

The valve body is cadmium plated and all other parts are made of corrosive resistant materials. Built for 250 lbs. maximum pressure, it is available in ⅛", ¼", ⅜", ½", ¾" and 1" pipe sizes.

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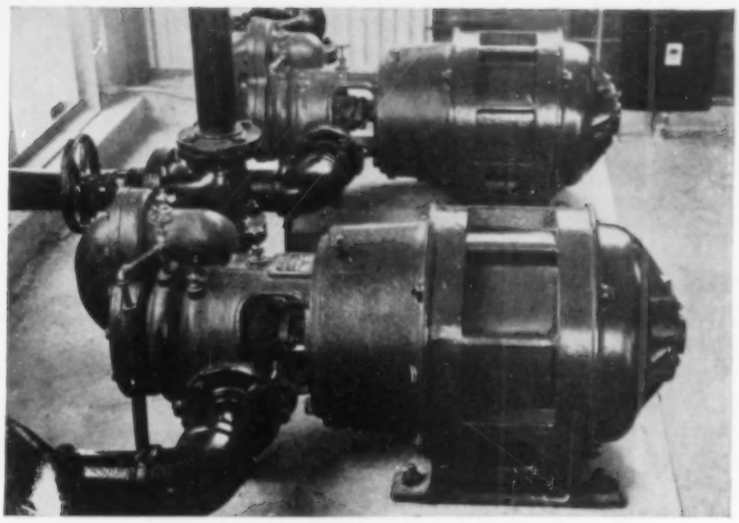

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There's a good reason why the shaft of this compact and efficient Motorpump is mounted on SKF Ball Bearings. The SKF Deep Groove Ball Bearing on the outboard end and the two SKF Angular Contact Thrust Bearings on the inboard end have *liberal thrust capacity*. These bearings are used to take the loads in Motorpumps conveying up to 1500 gallons of water per minute and against heads as high as 500 feet. Another way of saying, "Good pump design needs good bearing design."

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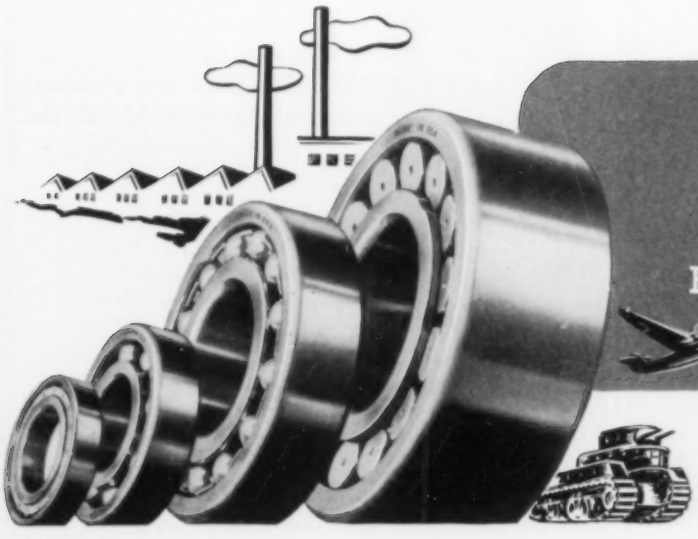

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Efficient and economical plant operation is vital to attain the unprecedented production levels demanded by the National Defense program.

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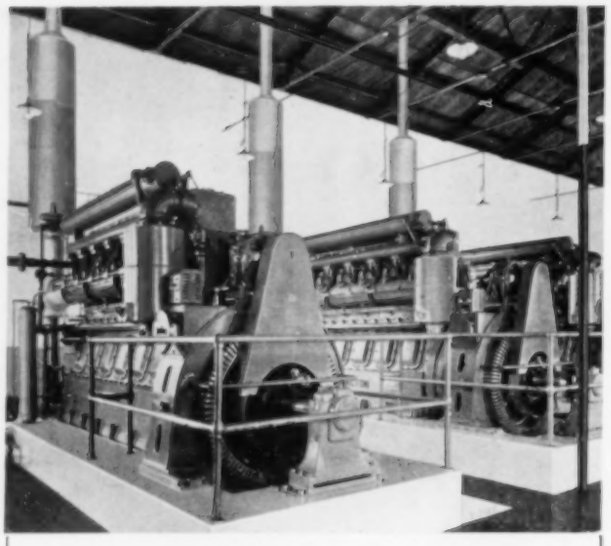

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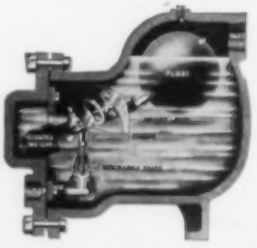

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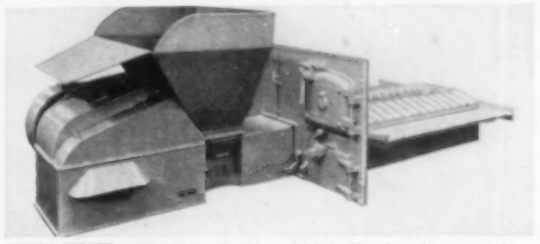
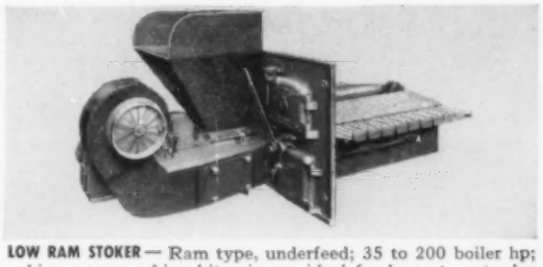
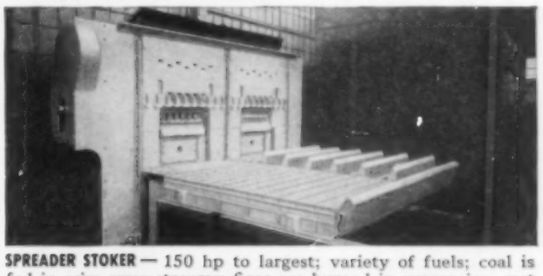


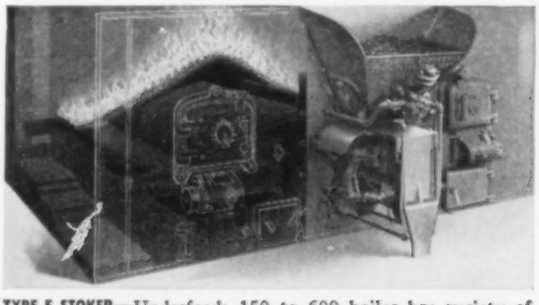
SKELLY STOKER— Underfeed; 20 to 200 boiler hp; burns anthracite or bituminous; has alternate fixed and moving grate bars; non-avalanching cantilever dump grates; integral forced-draft fan; sixteen rates of coal feed; automatic control; Timken bearings; Alemite lubrication.



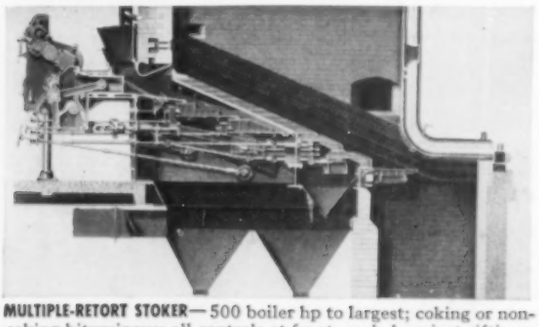
LOW RAM STOKER— Ram type, underfeed; 35 to 200 boiler hp; coking or non-coking bituminous; ideal for low-set, water-leg boilers; unit construction for easy installation, usually no foundation work; integral forced-draft fan and drive mechanism; ruggedly built; simple to operate.



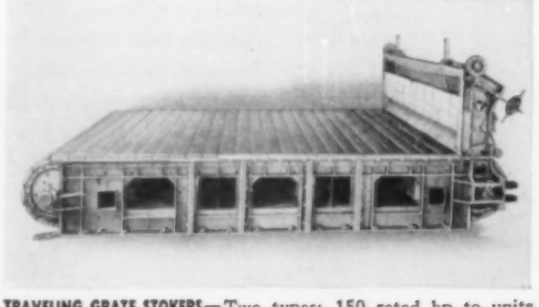
SPREADER STOKER— 150 hp to largest; variety of fuels; coal is fed in criss-cross streams; fines are burned in suspension, rest of coal on the grate, stationary or dumping; grate surface zoned for air control; wide control range for rate of feed and air supply.



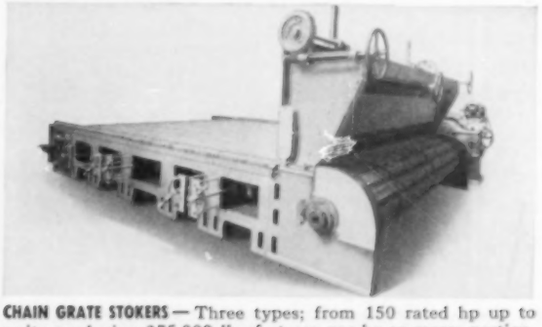
TYPE E STOKER—Underfeed; 150 to 600 boiler hp; variety of bituminous, especially caking and coking; ram feed; reciprocating sliding bottom; alternately fixed and moving, air-cooled grate bars providing for agitation of the fuel bed; zoned air control; over-fire air; steam, electric or hydraulic drive.



MULTIPLE-RETORT STOKER— 500 boiler hp to largest; coking or non-coking bituminous; all controls at front; sealed against siftings; reciprocating overfeed section; zoned air control; notable for uniform fire; ash disposal by steam dump, clinker grinder, continuous discharge.



TRAVELING GRATE STOKERS—Two types; 150 rated hp to units producing 200,000 lb of steam per hr or more; Coxe type is unequalled for small sizes of anthracite and coke breeze; also suited to lignite and some free-burning bituminous; both types forced-draft with zoned air control.



CHAIN GRATE STOKERS— Three types; from 150 rated hp up to units producing 275,000 lb of steam per hr or more; particularly well suited to the use of free-burning bituminous coals; available in either forced-draft or natural-draft designs.

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Maybe

YOU don't need Pneumatic Screw Drivers

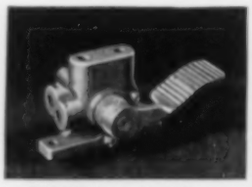
. . . but this one illustrates how NOPAK Valves and Cylinders may be used to meet urgent demands for Special Production Tools

Model D NOPAK Air Cylinder

A "dust explosion" hazard in a certain plant made it necessary to develop a battery of screw drivers with spark-free motors and friction-free mechanisms. Air powered, air controlled, screw drivers solved the problem quickly, economically, efficiently!

Though *specially built*, these machines were made up largely of standardized units mounted on a simple base and pedestal. A standard Model D NOPAK Cylinder provides the vertical movement. A standard NOPAK 4-way, Foot Operated Valve provides precision control. Other "ready made" units are the Air Turbine for rotary power, Pressure Gauge, Lubricator, standard shafting and piping.

Here, then, is a new tool, developed with a minimum of new patterns, new castings, new stampings—without costly delays for special production. Similar applications of NOPAK Valves and Cylinders may help you lick a defense "bottleneck" in your plant.



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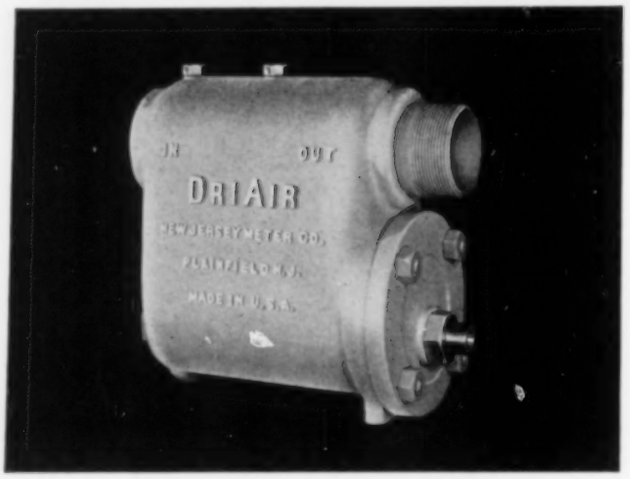

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DRIAIR

A COMPLETE SELF-CONTAINED UNIT

DriAir may be installed by suspending it from the piping without any other support.

A typical installation showing DriAir standing on the floor next to the wall.

● The answer to many problems which arise in various applications of compressed air, DriAir speeds production by separating and automatically ejecting the condensed water and oil from the air. DriAir collects dirt and rust from the air lines and delivers clean dry air to the tools, thus reducing wear and prolonging their life. All internal parts are made of bronze or copper—resistant to corrosion and practically permanent Copy of Bulletin DA fully describing the operation of DriAir sent on request; write today.

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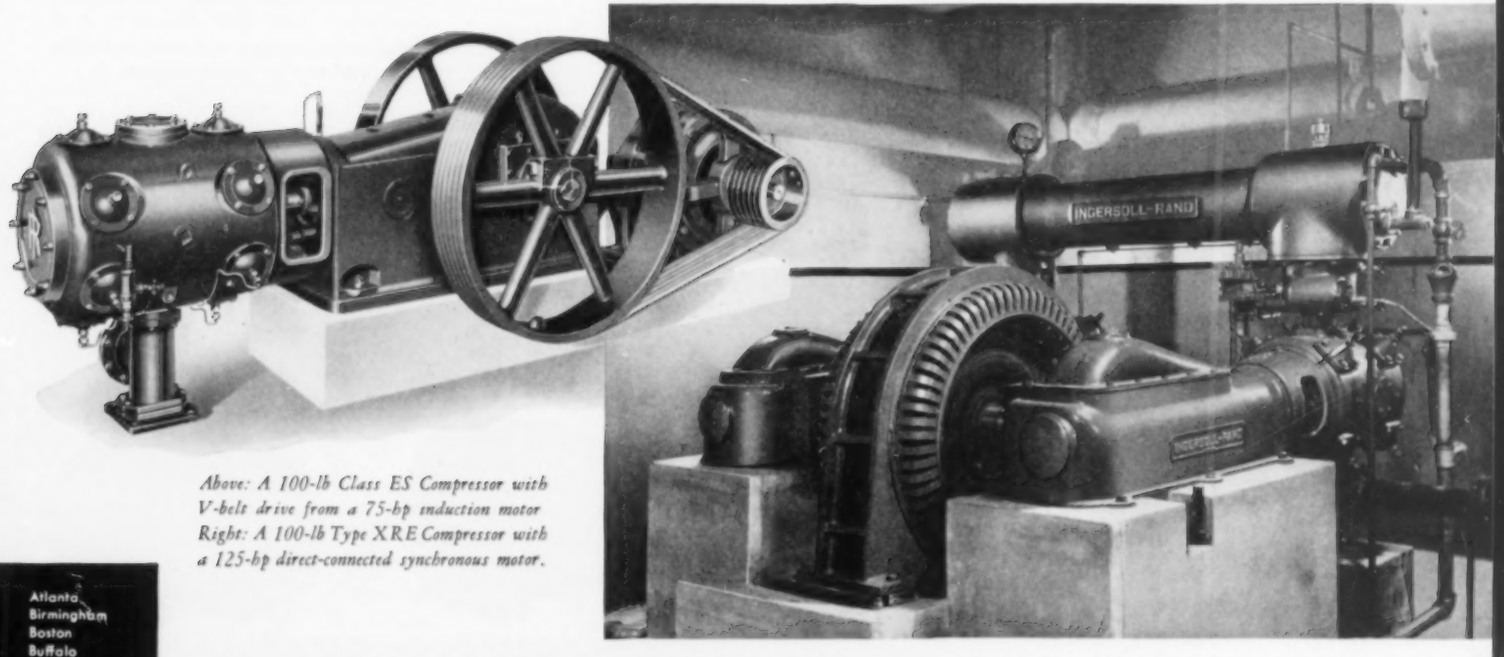
PLAINFIELD, NEW JERSEY

The Present Emergency

DEMANDS POWER SAVINGS!

As more and more industries add new equipment and work around the clock — more and more power will be needed. Power waste is serious in the present emergency.

Ingersoll-Rand Electric-Motor-Driven Compressors are doing their part



Above: A 100-lb Class ES Compressor with V-belt drive from a 75-hp induction motor Right: A 100-lb Type XRE Compressor with a 125-hp direct-connected synchronous motor.

The many thousands of electric-motor-driven air and gas compressors operating today consume a lot of power.

A medium-size 100-lb industrial compressor of about 1200-cfm capacity will consume more than 1,500,000 kilowatt hours in a year of continuous full-load operation.

A compressor 5% less efficient than a modern Ingersoll-Rand unit of this size, will use nearly 80,000 additional kilowatt hours a year — a needless waste of power in a time of emergency. The many thousands of efficient I-R compressors in use are making an important contribution by eliminating unnecessary waste of power.

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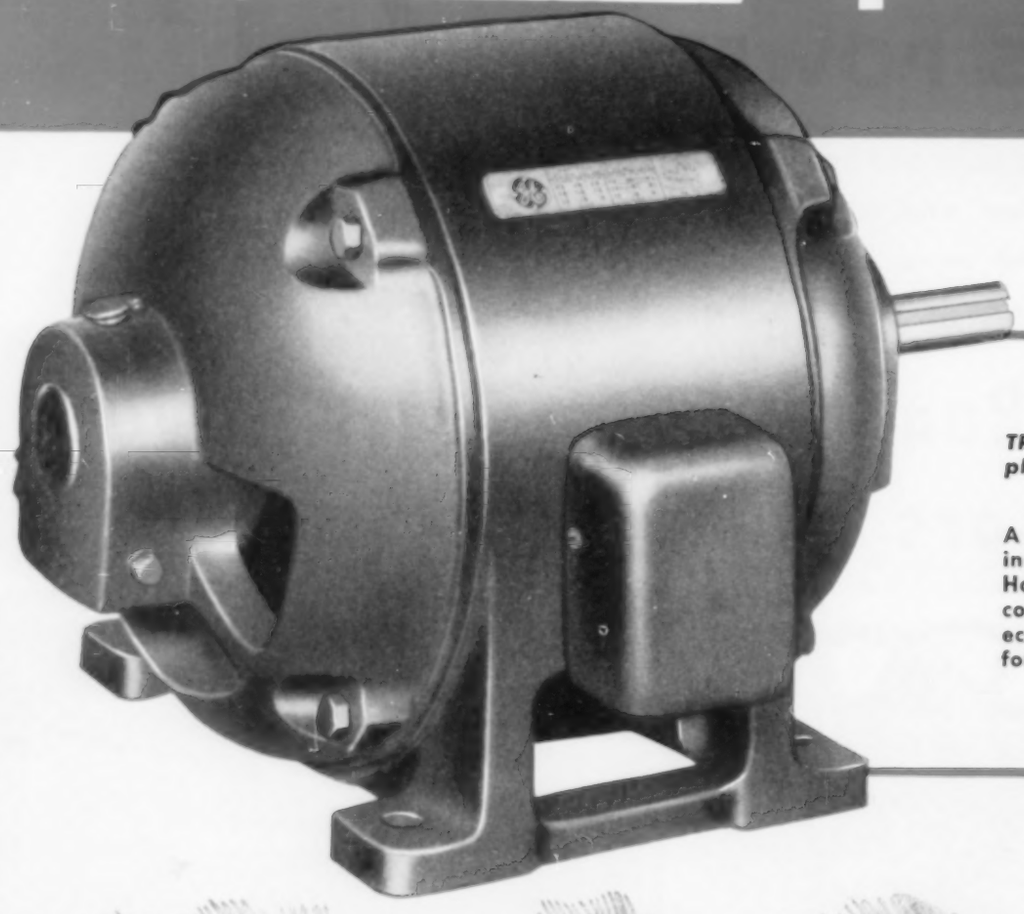
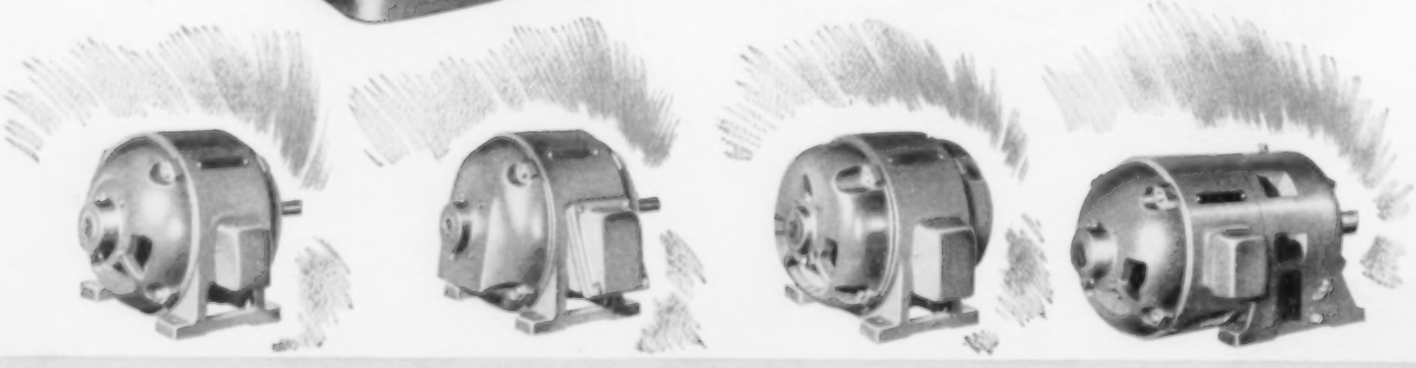


TRI-CLAD Sleeve-bearing Polyphase Industrial Motor Is Most Widely Used

A well-protected, open motor for industry's general-purpose needs. Horizontally mounted—for direct-connected and belt drives—it is economical to operate and suitable for a variety of applications.



TRI-CLAD Ball-bearing Polyphase Motor

Has additional advantage of being mountable in other than horizontal positions. Will take end thrust—for example, from beveled-gear pinion. Similar to the sleeve-bearing motor and, like it, available in many types.

TRI-CLAD Splashproof Ball-bearing Polyphase Motor

For use in wet surroundings, such as dairies, breweries, paper mills, canning factories, etc. Furnished with cast-iron, waterproof conduit box, deflecting end shields, and moisture-resistant insulation.

TRI-CLAD Capacitor-Motor (in sleeve-bearing or ball-bearing types)

For single-phase operation. Available in types to drive such devices as compressors, pumps, fans, etc. No radio interference; no brushes to wear; quiet operation.

TRI-CLAD Gear-Motor

For economical, compact, low-speed direct or pinion drive. Wide range of output speeds available. Open, splashproof, and capacitor-motor construction. Oil- and dust-tight housings reduce maintenance.

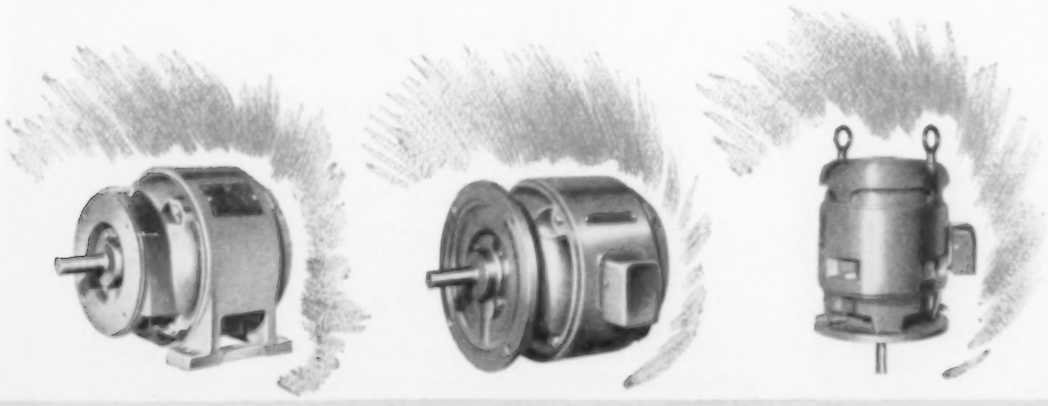
Built for Protection First.....to Last!

is now a *family affair!*

THE improvements in Tri-Clad motor design are *fundamental* improvements, not just "sales features" to popularize a new model. That's why they are being extended, month by month, to a whole family of G-E integral-horsepower motors—both general-purpose and special types.

So, in these special fields you can now count on getting the same benefits of extra protection that have made the *general-purpose* Tri-Clad motor the acknowledged leader in performance and service life.

All these new members of the Tri-Clad family are the result of basic redesign to meet modern industrial conditions. Each has new performance and convenience features important to its particular field of service. For complete information on the right Tri-Clad motor for *your* application, consult our local office, or write General Electric Company, Schenectady, N. Y.



TRI-CLAD Ball-bearing Induction Motor, with Face-type End-shield Mounting
For close-coupled attachment to machine tools, compressors, pumps, etc. Motor bolted from driven machine. A few standard mounting dimensions apply to many motor ratings.

TRI-CLAD Round-frame, Ball-bearing Induction Motor, with Flange-type End-shield Mounting
For close-coupled attachment, or direct bolting to driven machine. Mounting dimensions are standard, but larger than those of face-type end shield.

TRI-CLAD Vertical Motor
For general-purpose fan, pump, and machine drives in vertical position. Openings protected and bearings designed for vertical operation. Both polyphase and capacitor-motors available with variety of bases.

Today a wider range of your special needs can be filled by the growing Tri-Clad motor family. Every member offers extra strength and longer life because of these 3 "extras":

Extra Protection
AGAINST PHYSICAL DAMAGE
Sturdy, cast-iron frame and end-shield construction.

Extra Protection
AGAINST ELECTRICAL BREAKDOWN
Stator windings of Formex wire, "armored" by synthetic resins against moisture, heat, oil, and abrasion.

Extra Protection
AGAINST OPERATING WEAR AND TEAR
New sleeve-bearing design and improved ball-bearing mounting lengthen life.

In addition, you'll find the modifications to meet special requirements are soundly engineered to give you space-saving, time-saving, and money-saving advantages all down the line. Consult your G-E representative for Tri-Clad horsepower ratings now available.

GENERAL ELECTRIC

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RICHMOND 10-WAY PROFIT PLAN

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Specifically engineered products and especially planned methods makes the RICHMOND way the best way in concrete form work.

Erect a wall section or complicated engineering structure, Richmond helps you do the job better, faster and with more profit.

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JARECKI VALVES
Sizes and types to meet every condition, each soundly built, perfectly threaded and individually tested.

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Maintains constant pressure by governing inlet of compressor. Loads and unloads without shock or strain.

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For steam engines, pumps or compressors. For speed control only or for combined speed and pressure control.

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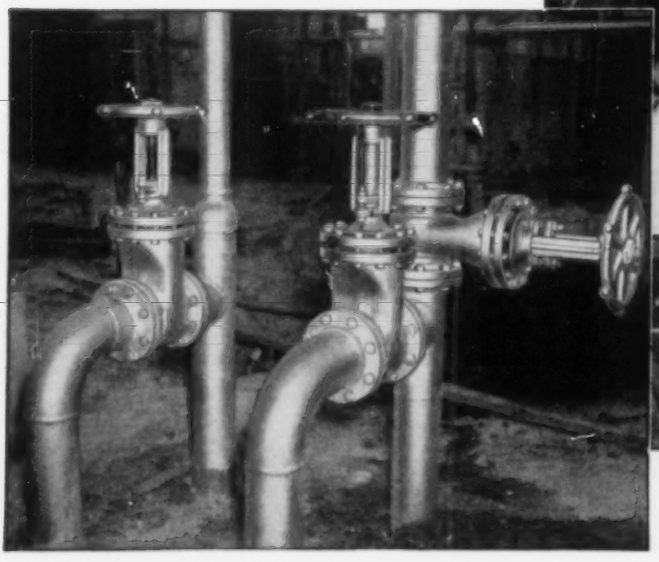

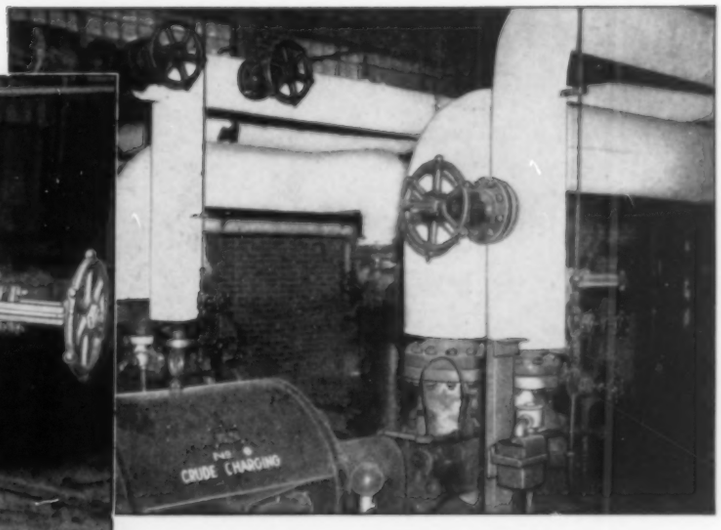

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GATE VALVES

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In the catalytic cracking processes where extremely high temperatures and low pressures prevail, Vogt's new 150 Pound and 300 Pound, A. S. A. DROP FORGED STEEL Gate Valves are successfully operating under severe conditions.

The standard temperature rating for 150 Pound valves is 500° F.; Vogt rates its construction at 750° F.; but the Vogt drop forged carbon steel valves shown above are OPERATING REGULARLY AT 850° F. in one of the world's largest refineries.

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For doing a tough job... it's VOGT for Valves!

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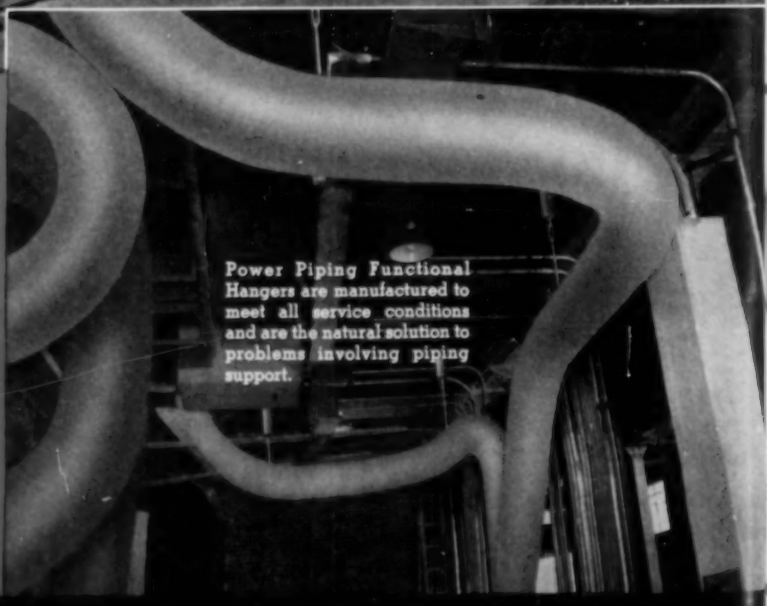
Another
BLAW-KNOX POWER PIPING
Achievement

The photographs show sections of a power piping system DESIGNED, FABRICATED AND ERECTED by Blaw-Knox Company — Power Piping Division. This includes 14" boiler leads forming an 18" x 14", concentric swage fitting and 10" feedwater assembly, prefabricated by exact methods to insure predetermined results. Power Piping Functional Hangers were used as the most expedient method for supporting the line.

Regardless of size of job or pressure-temperature conditions specify POWER PIPING DIVISION service.

A copy of FLEX-ANAL CHARTS will be sent to any engineer asking for it on his letterhead. Ask also for bulletin entitled POWER PIPING FUNCTIONAL HANGERS AND VIBRATION ELIMINATORS.



Power Piping Functional Hangers are manufactured to meet all service conditions and are the natural solution to problems involving piping support.

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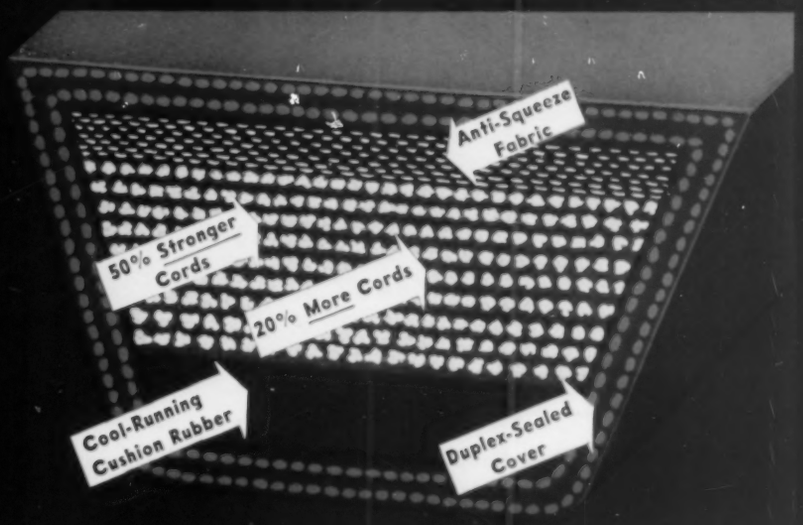
NEWEST V-BELT ON THE MARKET
TEXROPE SUPER-7

1 50% STRONGER CORDS! Sensational new Flexon process makes cords 50% stronger than even those in former great Texrope belts.

2 20% MORE CORDS! Count them! You get 20% more of these tough, extra pulling power cords in every Texrope Super-7.

3 INCREASED LIFE! Cords float on amazing cool-running cushion rubber that absorbs shock . . . actually increases belt life phenomenally.

4 EXTRA PROTECTION! Exclusive duplex-sealed cover protects pulling cords against dirt, grit, moisture, and other adverse elements.

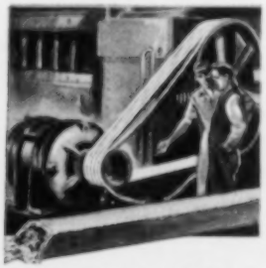


SINCE Allis-Chalmers invented and introduced multiple V-belts sixteen years ago, developments and improvements have been steady...each new type better than the one before... Now, comes the latest and best of them all — the new Allis-Chalmers Texrope* Super-7 V-belt! Without costing any more, it gives you longer life . . . more pulling power . . . greater resistance to stretch. Here's why —

It has 50% stronger cords...20% more cords . . . and a special new cool-running rubber compound that resists heat . . . absorbs shocks . . . gives years more service. What's more — we wrap the belt in a new "duplex-sealed" two-ply cover that gives extra protection against dirt, moisture, and other adverse elements.

When you order V-belts, get the best . . . *and the best is Texrope Super-7!*

For complete details, call your Texrope dealer or the Allis-Chalmers district office near you. Or write Allis-Chalmers, Milwaukee, Wisconsin.



LOOK OUT FOR DANGER in belts with stiff, unpliable cords! Such belts *look* strong . . . but actually they buckle over sheaves, build up excessive heat that attacks pulling cords. Result: Belt failure far sooner than you expect it.

WARNING SIGN! Sagging, slipping belts mean too much stretch not backed up by balanced cord strength. Motor must be pulled back often to take up slack. Result: When stretch limit is reached belt breaks under tension.

SUPER-7 TEXROPE BELTS are made by amazing Flexon process that *combines* flexibility with low stretch . . . great strength. Cords float on cool-running, shock absorbing cushion rubber. Result: *true* strength . . . *true* pulling power . . . *true* endurance.

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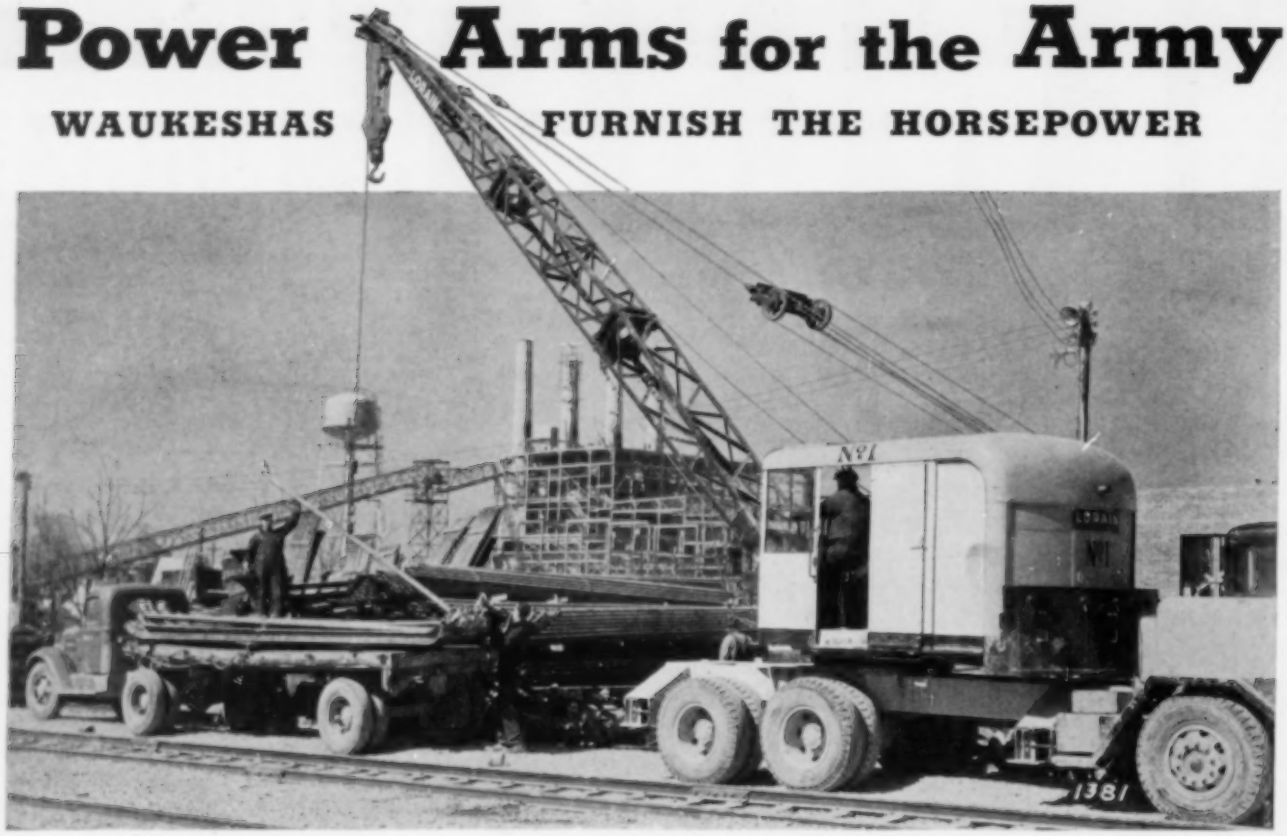
WAUKESHAS FURNISH THE HORSEPOWER



Photograph courtesy of Thew Shovel Company.

Like huge human arms . . . but infinitely more powerful proportionately, and *untiring* . . . the crane booms move with military precision. And it's Waukesha Engines that put the power in these power arms that are helping to arm the army.

This Lorain Moto-Crane is moving tons of steel for the Army's new Indiana Ordnance Plant at Charlestown, Indiana. The crane turntable is powered by a 65-70 hp. super-six Model MZR Waukesha Engine; the crane carrier by an 80 to 90 hp. Model SRKR Waukesha Engine.

When producing or manufacturing facilities vital to defense are being built or expanded, contractors and their machinery makers can't take time to ponder engine dependability. They must know that dependability is *built-in*, as Waukesha builds in dependability.

The Waukesha Blue Flame Manifold, for instance, gives quick acceleration, with smoothness of operation. The engine will swing into action *instantly* with no bucking or harshness whatever.

The Waukesha Controlled Turbulence cylinder head provides a higher power and torque output with smooth, progressive combustion—with non-premium gasolines.

These are but two of the many greater-dependability higher-economy longer-life features of Waukesha Gasoline and Oil Engines for Industrial, Stationary and Automotive Power. Sizes from 5 hp. to over 300 hp. *Get Bulletin 1079.*

WAUKESHA MOTOR COMPANY, WAUKESHA, WIS.

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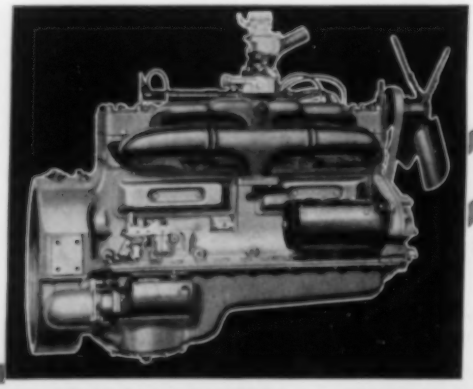

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WAUKESHA ENGINES

NEW!!

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The new D-505 Tunnel-IR is an extremely durable and powerful drifter.

For more than a year, it has been used successfully under the toughest drilling conditions on tunnel jobs and in mines throughout the country. Accurate records of both wear and performance proved two important things—first, it is the most durable drifter we have ever built and second, it is the fastest.

This drifter has been designed for heavy duty work—fast drilling in hard rock. It makes an ideal machine for use on drill jumbos now widely used on tunnel jobs and for increasing production in mines.

If you need a heavy-duty drill on your job, we believe the D-505 will lower the costs and speed up the work.

Consult our nearest office or send for catalogue 2786.

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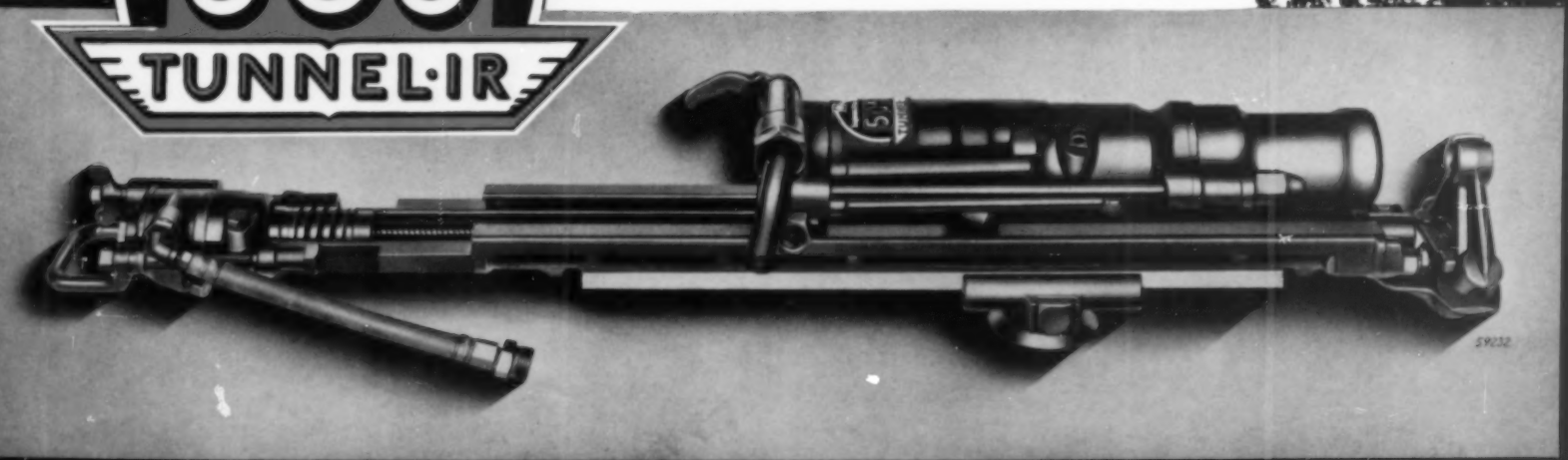

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